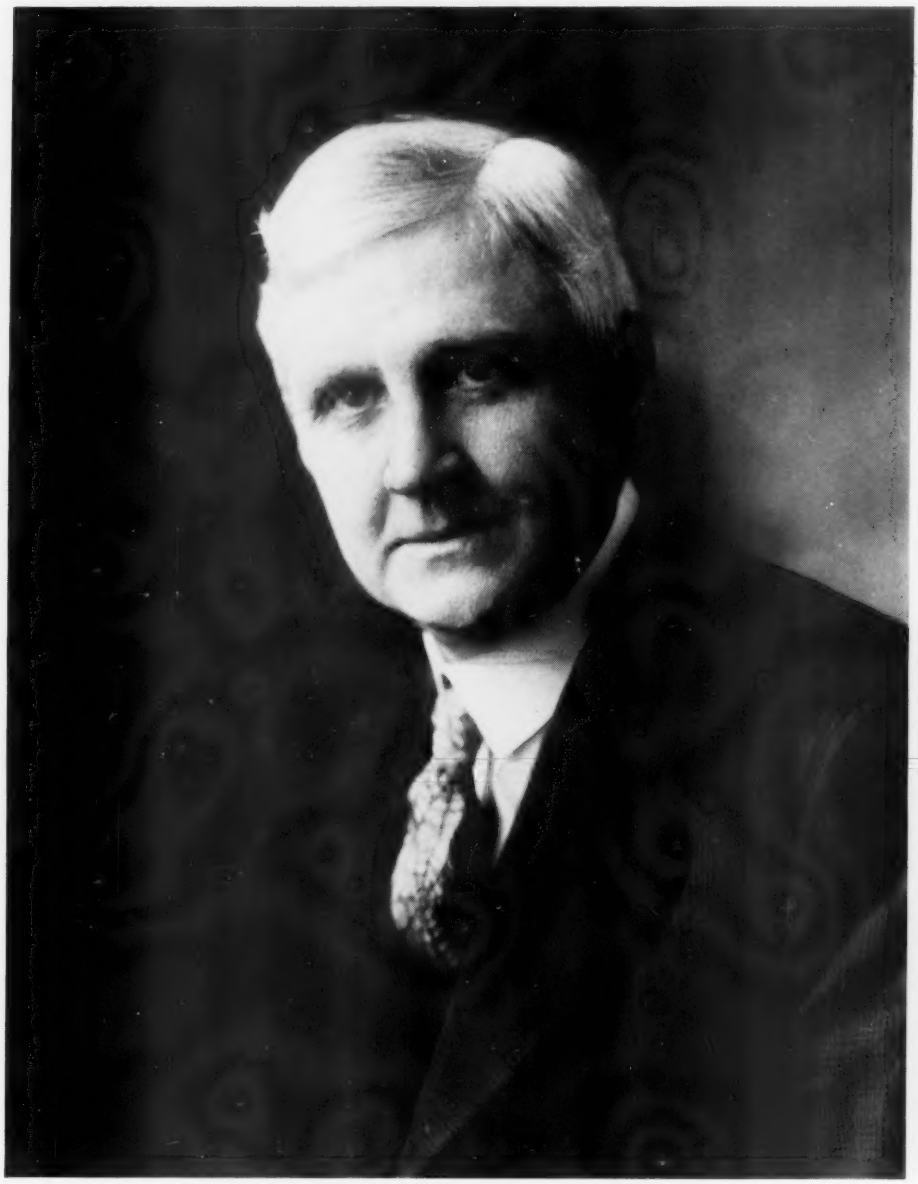
THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 20 MAY, 1941 Number 5



JAMES MACMATH SMITH

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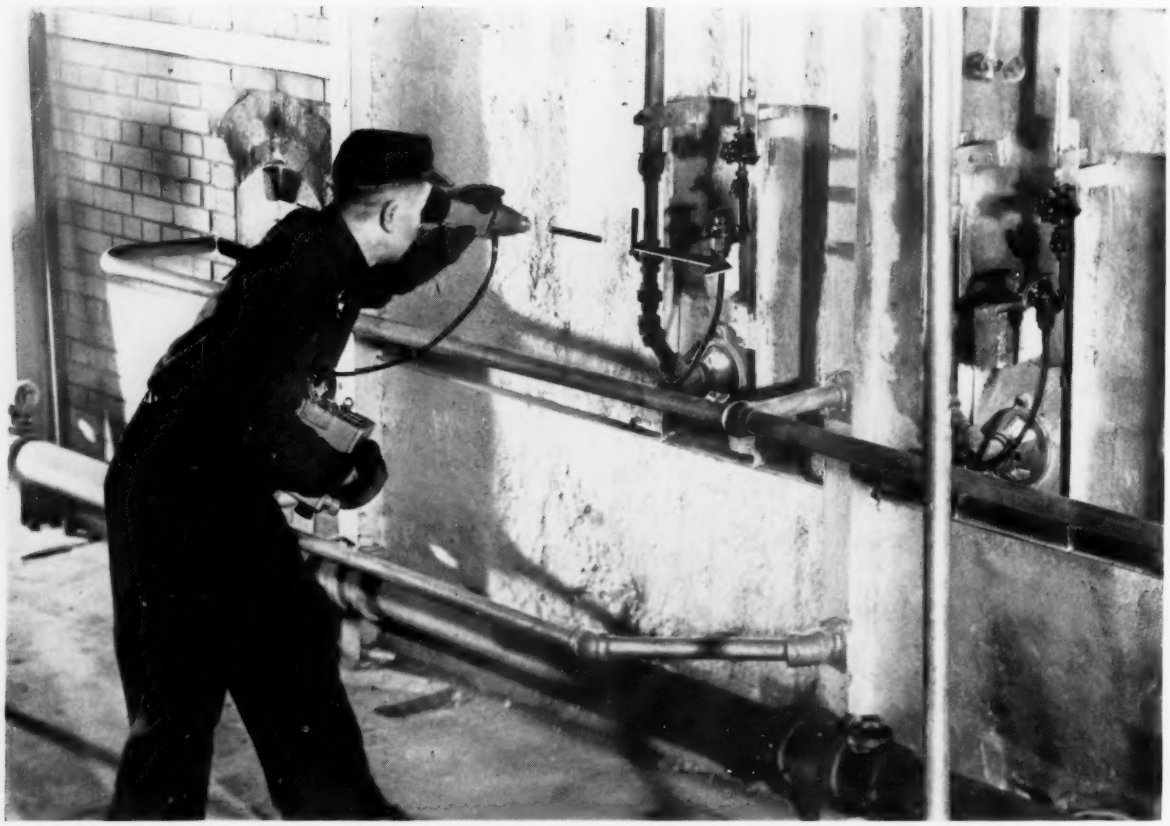

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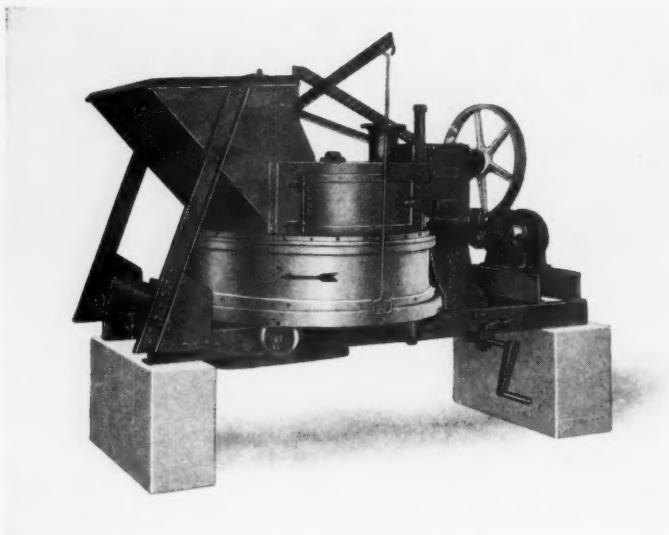

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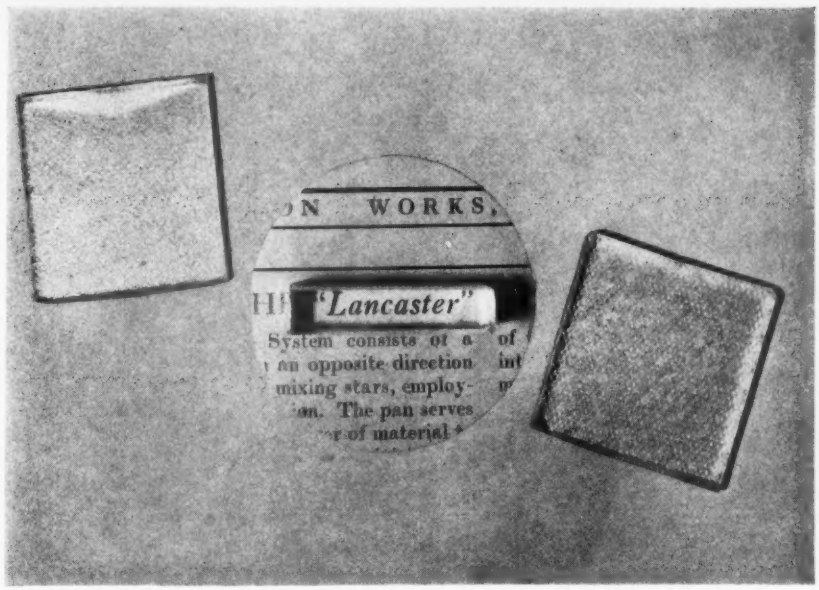

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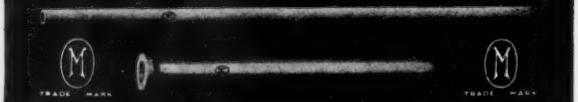

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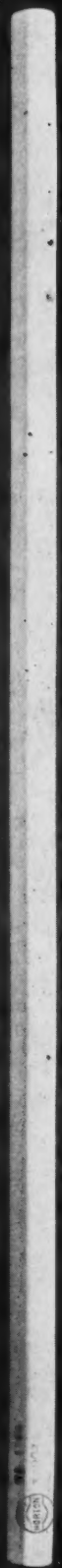

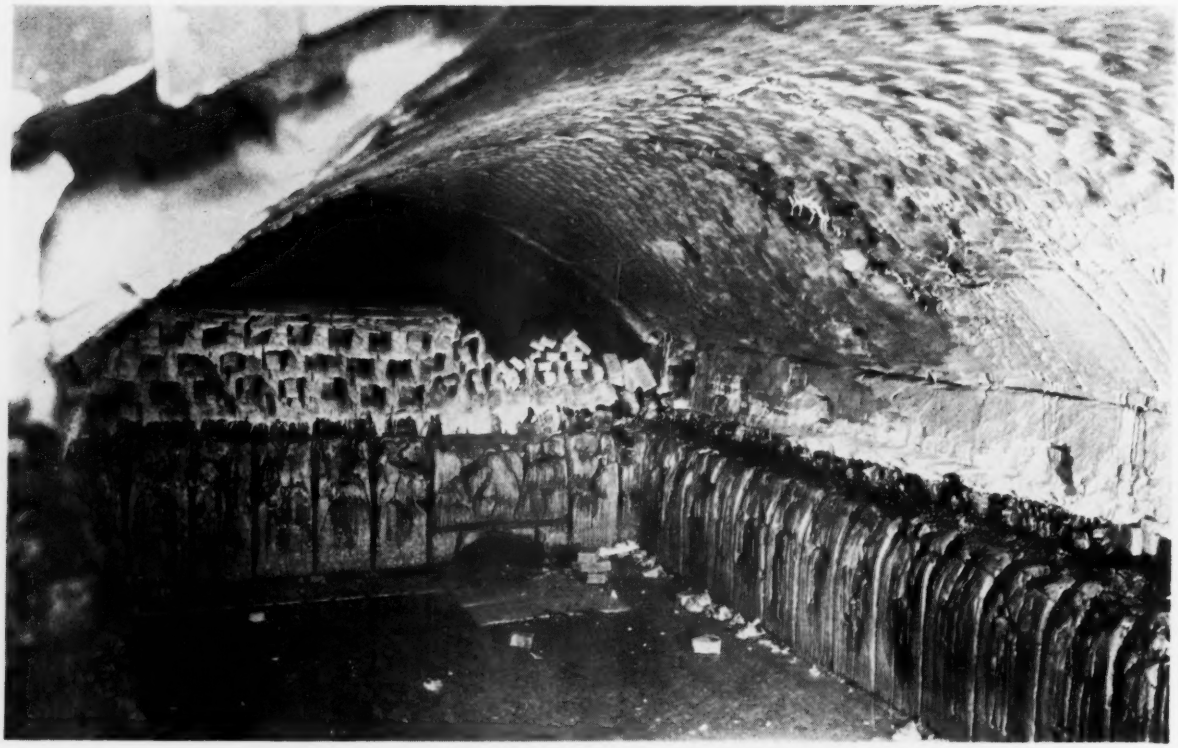

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A Monthly Publication Devoted to Proceedings of The Society and Promotion of Cooperative Research of Technical, Scientific, and Art Questions

Volume 20 **MAY, 1941** **Number 5**

PAPERS

INCREASING PLASTICITY AND DRY STRENGTH OF FLINT AND SEMIFLINT CLAYS BY TREATMENT WITH ELECTROLYTES*

By E. B. Snyder and R. M. King

Abstract

Typical flint and semiflint clays were obtained from the Missouri, Kentucky, and Pennsylvania regions and were treated for six months with several electrolytes. These treated clays were incorporated in batches, and tests were made to determine what effect the aging with electrolytes had on their physical properties. Pyrometric cone equivalent determinations were made on the treated and untreated clays that showed marked improvement in plasticity to determine whether the cone fusion of the clays had been materially lowered by the addition of the electrolyte.

I. Introduction

The addition of certain electrolytes, such as alkali salts, particularly alkali phosphates, to some clays brings about increased plasticity, especially when the clays are aged for a short time. The object of this study was to determine the effect of selected electrolytes on the plasticity and refractoriness of some well-known fire clays. No literature could be found on the use of electrolytes for the development of plasticity in flint fire clays.

II. Preliminary Work

A preliminary study[1] was made with a flint and a semiflint clay from Kentucky and a similar pair of clays from Missouri. To speed up the aging process, each of these clays was ground in ball mills until about 90% had passed a 200-mesh sieve. Batches were aged for four weeks with 0.5% by weight of each of the following electrolytes: trisodium phosphate, aluminum chloride, soda zeolite, and magnesium chloride. For a blank or control, one batch of each clay was aged with distilled water. Bars were then made from the batches and dry strengths were determined. The results are shown in Table I.

The outstanding conclusion from these data is that in general trisodium phosphate is the most effective of all the electrolytes in producing increased plasticity both as to the number of clays affected and as to the percentage increase of dry strength for each clay. The plasticity of the clays referred to in Table I was determined by the workability and feel of the clays in a soft-mud consistency. The other electrolytes, especially soda zeolite, increased the dry strength of one or two of the clays. The results, however, were not promising enough to warrant further study.

Table I

Electrolyte	Dry modulus (lb./sq. in.)			
	Mo. semiflint clay	Mo. flint clay	Olive Hill semiflint clay	Olive Hill flint clay
Soda zeolite	162	165	121	148
Aluminum chloride	135	67	98	98
Trisodium phosphate	297	81	201	189
Magnesium chloride	170	70	135	155
Blank with distilled water	195	75	135	115

* Presented at the Forty-Second Annual Meeting, The American Ceramic Society, Toronto, Canada, April 9, 1940 (Refractories Division). Received April 9, 1940.

[1] E. B. Snyder, "Increasing Plasticity and Dry Strength of Flint and Semiflint Clays by Treatment With Electrolytes." Thesis presented for the degree of B.Cer.E., Ohio State University, 1938.

III. Influence of Other Phosphates

Inasmuch as trisodium phosphate was the most effective of the electrolytes in increasing plasticity in the previous study,[1] two other sodium phosphates and three magnesium phosphates were used to age flint and semiflint clays in a further study.[2] The magnesium phosphates were used because of the writers' belief that bentonite owes much of its great plasticity to magnesium salts and because the chief mineral in bentonite is montmorillonite, which contains a large amount of magnesium ($MgO \cdot Al_2O_3 \cdot 5SiO_2 \cdot nH_2O$). The phosphates used were trisodium phosphate (Na_3PO_4), disodium phosphate (Na_2HPO_4), monosodium phosphate ($NaH_2PO_4 \cdot H_2O$), tertiary magnesium phosphate ($Mg_3PO_4 \cdot 8H_2O$), secondary magnesium phosphate ($MgHPO_4 \cdot 3H_2O$), and primary magnesium phosphate ($MgH_4(PO_4)_2 \cdot H_2O$).

In addition to the Kentucky and Missouri flint and semiflint clays, Pennsylvania (Draucker) flint and semiflint clays were used.

IV. Procedure

Fifty pounds of each of the clays from the various regions were ground to pass a 20-mesh screen and were divided into seven 7-lb. batches; 0.5% by weight of an electrolyte plus enough distilled water to make a slurry was added to six of the seven batches. Only distilled water was added to the seventh batch, which was used as a control. The seven batches were aged for six months; once a week, the batches were thoroughly mixed, and distilled water was added if it was needed. Two weeks before the end of the six-month period, the covers were removed from the jars and the clays were allowed to dry to a soft-mud consistency. Bodies were then made up according to the following formula:

	(lb.)	(%)
Treated semiflint clay	5	27.77
Treated flint clay	7	38.88
Untreated flint clay	6	33.33

As the untreated flint clay used in these bodies was ground to pass 8-mesh, these resulting bodies were a mixture of 8- and 20-mesh material. The flint and semiflint clays from the same region were combined in each body, that is, Missouri flint and semiflint, Kentucky flint and semiflint, and Pennsylvania flint and semiflint clays. After these bodies had been thoroughly mixed with enough water for dry-press consistency as determined by "feel," they were pressed into 4- by 1- by 1-in. bars at a pressure of 2000 lb. per sq. in. Approximately 38 bars were made from each batch. Water of plasticity was determined on every eighth bar, and the dry strength was determined on 18 bars taken at random. Twenty bars were fired to cone 15, and the shrinkage on firing, water absorption, modulus of rupture, and loss of weight were determined. Pyrometric cone equivalent determinations were made on all raw clays and on clays which showed a marked increase in dry strength.

[1] E. B. Snyder, "Increasing Plasticity of Flint and Semiflint Clays by Treatment with Electrolytes." Thesis presented for degree of M.Sc., Ohio State University, 1940.

V. Results

The pertinent data obtained are set forth in Tables I and II; Fig. 1 shows the relation between dry strength and electrolyte for the various clays.

TABLE II

Clay	P.C.E. determination		
	Raw clay	Na_3PO_4	$MgHPO_4 \cdot 3H_2O$
Mo. flint	34	34[2]	34[3]
Ky. flint	33	33	33

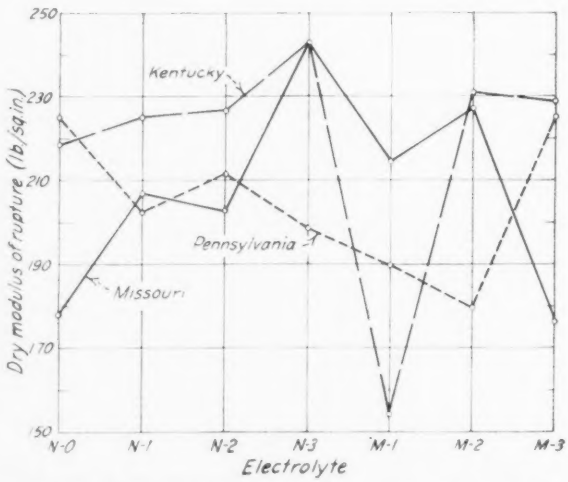

FIG. 1.—Comparison of dry strengths of flint-clay mixtures aged with various electrolytes. N-0, control; N-1, $NaH_2PO_4 \cdot H_2O$; N-2, Na_2HPO_4; N-3, Na_3PO_4; M-1, $MgH_4(PO_4)_2 \cdot H_2O$; M-2, $MgHPO_4 \cdot H_2O$; M-3, $Mg_3PO_4 \cdot H_2O$.

VI. Interpretation of Results

The effect of the aging with electrolyte varied with the type of clay used. In one body, the dry strength was decreased by the aging process, and large increases in dry strength were indicated in two of the bodies. No increase was noted either in the plasticity or dry strength of the clays from the Pennsylvania region. The aging of the Pennsylvania clays with electrolytes seemed to have a harmful rather than beneficial effect on dry strength; in fact, in three batches, a marked decrease in strength was noted. The available data, however, provide no explanation for this weakening effect.

Missouri and Kentucky clays treated with trisodium phosphate (Na_3PO_4) showed the greatest increase in dry strength, with secondary magnesium phosphate ($MgHPO_4 \cdot 3H_2O$) rating second.

The plasticity of the Kentucky clays was increased appreciably except when primary magnesium phosphate was used. This electrolyte apparently brought about a marked decrease in plasticity and dry strength, but this decrease was probably caused by the extremely low water content of this batch.

TABLE III

Clay		Electrolyte	Water of plasticity (%)	Dry modulus (lb./sq. in.)	Fired modulus (lb./sq. in.)	Fired shrinkage (%)	Loss of weight fired (%)
1-N-0	Mo.	None	6.23	178.08	1670	10	3.05
1-N-1	"	Monosodium phosphate	7.57	206.81	1700	10	2.31
1-N-2	"	Disodium "	6.57	202.82	1590	9	3.00
1-N-3	"	Trisodium "	8.36	242.71	1960	9	3.19
1-M-1	"	Primary magnesium phosphate	7.74	214.28	1740	11	2.29
1-M-2	"	Secondary " "	8.25	226.79	2050	11	2.04
1-M-3	"	Tertiary " "	5.50	176.08	1830	11	2.10
3-N-0	Ky.	None	7.85	218.68	2000	8	3.27
3-N-1	"	Monosodium phosphate	8.11	225.09	1870	8	3.89
3-N-2	"	Disodium "	7.86	226.63	1800	8	2.89
3-N-3	"	Trisodium "	7.76	242.74	1700	8	3.85
3-M-1	"	Primary magnesium phosphate	5.72	154.06	1470	8	5.44
3-M-2	"	Secondary " "	6.37	230.63	1960	8	3.70
3-M-3	"	Tertiary " "	9.42	228.86	2640	8	3.28
5-N-0	Pa.	None	6.46	225.08	2950	3	5.92
5-N-1	"	Monosodium phosphate	7.82	202.25	2860	3	5.40
5-N-2	"	Disodium "	6.72	211.13	2540	3	4.89
5-N-3	"	Trisodium "	5.83	198.38	2300	2	5.63
5-M-1	"	Primary magnesium phosphate	5.89	189.51	2290	2	5.56
5-M-2	"	Secondary " "	4.70	179.15	2500	2	6.47
5-M-3	"	Tertiary " "	6.56	224.75	2510	3	5.17

Dry shrinkage was 0.25% throughout.

Batches containing Missouri clays showed the greatest increase in dry strength except when tertiary magnesium phosphate was used. Here again, the dry strength probably was decreased by the low water content of the batch.

VII. Conclusions

The dry strength of the Pennsylvania clays was decreased by aging with each of the six electrolytes.

The plasticity or dry strength of the Kentucky and Missouri clays was appreciably increased by aging with trisodium phosphate and secondary magnesium phosphate. Clays that were aged with trisodium phosphate showed the greatest increase in dry strength, reaching a maximum of 35%. In the case of Kentucky clays, secondary magnesium phosphate increased the dry strength by a maximum of 27%.

In no instance in which the P.C.E. value of the clay was checked was it lowered more than $^1/_2$ cone. This small difference in refractoriness would seem to indicate that these electrolytes could be used to improve plasticity without materially lowering the refractoriness of the clay.

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DETERMINATION OF FUSION CHARACTERISTICS OF NONPLASTIC MATERIALS*

BY ARTHUR J. BLUME

ABSTRACT

A method of testing nonplastic materials is described. Small series cones were made of the nonplastic materials in the same proportions as were used in the body. These cones were fired and variations from standard were determined.

I. Introduction

A good whiteware body is produced when the plastic and nonplastic materials of which it is made are properly balanced within themselves and with each other.

The nonplastic unit has a slight effect on the forming properties of the body, but this is secondary to its main function of fusion or glassforming. To test nonplastic materials, a method of testing their fusion properties should be used which will produce results that may be given a numerical value and that may be checked against a standard. For this reason, the materials to be tested were made up into cones of the same dimensions as the standard small series cones,

* Presented at the Autumn Meeting, White Wares and Materials and Equipment Divisions, Uniontown, Pa., September 14, 1940. Received December 14, 1940.

and their deformation was checked against the standard small series cones.

The test method was devised (1) to check the uniformity of nonplastic shipments and (2) to determine the blend of nonplastics to use when new and untried nonplastic materials are used.

II. Test Method

A simplified dry-press electrical porcelain body for use at cone 11 without auxiliary fluxes has the following formula: nonplastics (total 60%), consisting of feldspar 40, pyrophyllite 10, and flint 10% and plastics (total 40%), with E.P.K. china clay 20% and Tenn. No. 5 ball clay 20%.

When the nonplastic addition, totaling 60 parts, is made up into the small series cones and fired, it has the same deformation as the cone 10 small series. A triaxial was made up around this nonplastic composition, and the following relationships were determined: (1) When the feldspar and flint content is varied with the pyrophyllite constant, 5.75 parts equal 1 P.C.E.; (2) when the feldspar and pyrophyllite content is varied with the flint constant, 4.5 parts equal 1 P.C.E.; and (3) when the flint and pyrophyllite content is varied with the feldspar constant, 20 parts equal 1 P.C.E.

The formula, feldspar 40, pyrophyllite 10, and flint 10%, has been set up as a standard which equals the cone 10 small series. A large batch of this formula has been made up and kept as a standard batch. When a new shipment is received, a sample is made up into the standard formula and fired with a standard batch cone and with a set of small series cones. If the new material shows a deviation from the standard, the factory batches are adjusted on the basis of the listed relationships so that the P.C.E. of the nonplastic addition is equal to cone 10.

When a new material is tried, it is made into the standard cone and fired. The deviation from the standard is noted and the batch, adjusted so that it has the same deformation as cone 10, becomes the nonplastic addition. The theory has been developed that the source and type of the fluxing material may vary widely provided the total nonplastic addition has the standard deformation.

This theory is confirmed by the data given in Table I. These bodies are identical in that the same clays are used, they have nonplastic additions equal to 60%, and the nonplastic additions have the same deformation as cone 10. They were prepared in a Lancaster mixer, dry-pressed into standard bars on a commercial hand press, and fired in adjacent saggers in a Harrop tunnel kiln.

TABLE I

Nonplastic 60%					
S. D. feldspar	40				25
Nepheline syenite		30			
N. C. feldspar No. 56			36		
Lithospar				28	8
Flint	10	20	14	22	17
H. S. pyrophyllite	10	10	10	10	10
Plastic 40%					
E.P.K. china clay	20	20	20	20	20
Tenn. ball clay No. 5	20	20	20	20	20
Modulus of rupture (lb./sq. in.)	4870	4730	4810	4840	4750
Total shrinkage (%)	12.8	12.4	13.2	12.5	13.6
Impact (drop in 1/4 in.)	7.6	7.0	8.0	10.3	7.5
Absorption (%)	0.62	0.80	0.41	0.39	0.35
Slump (in. on 6-in. span)	0.30	0.26	0.25	0.28	0.28

These fired bodies are similar, considering the wide variation in the nonplastic additions.

One limitation in using this test method is that the standard cones must be fired to the same end point each time, because the bending interval of the test cones will differ from the standard cones. Interpretations of 1/4 P.C.E. may be made if the standard cones are brought down to a predetermined point and comparisons are made between the standard and test cones. This is equal to 1 1/2% in the flint-feldspar ratio and is sufficiently accurate for plant control work.

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CONTROL OF CLAYS CONTAINING VARYING QUANTITIES OF ADSORBED SALTS*

By C. M. Lambe, Jr.

Abstract

The effect of the use of barium carbonate and sodium silicate to control the adsorbed salts in English and domestic clays was studied. The process used is described and the results of the tests are given on Jernigan ball clay, M. & M. English ball clay, English china clay No. 44, and M. & M. Georgia kaolin No. 27. The deflocculation test not only affords a means to control the viscosity of a clay slip but it provides an excellent control for ball clays that contain varying quantities of adsorbed salts.

I. Introduction

The replacement of foreign clays by American clays has introduced problems which have necessitated changes in production methods. These problems are often complicated by large percentages and varying amounts of adsorbed salts, particularly in ball clays. Various reagents have been used to precipitate these salts. Compounds of barium have been used with sodium silicate as well as various oxalates, tannates, and other organic deflocculants. The difficulty of control of the final slip is one of the disadvantages of the precipitation of the adsorbed salts.

Some of these compounds have such a short range and their action is so powerful that great care in their use is essential. The use of other agents is successful when the correct amounts are added. They have an inhibiting effect on each other, however, when an excess of either is present, particularly barium carbonate and sodium silicate. When an excessive amount of barium carbonate is added to the slip, even with a large quantity of sodium silicate, the slip casts slowly and it remains soft long after it should be dry. On the other hand, if not enough barium carbonate is present and deflocculation is obtained with silicate, the slip is stringy and slow casting and the resulting ware is thin, hard, and brittle and offers considerable trouble in trimming. The amounts of barium and silicate compounds therefore must be balanced and the minimum quantity of each be used.

If the various adsorbed salts were always in the same relative proportions and total amounts, the ratio of barium carbonate to silicate necessary for complete precipitation and deflocculation might be determined. The content changes in character and quantity, and the determination of the correct amount of each reagent is often difficult and much slip is mishandled before the correct balance is determined.

The test described here has proved to be satisfactory from the standpoints of accuracy, speed, and simplicity, and since May, 1940, when it was inaugurated, the slip has never been too hard and it is rarely too soft. During this time, however, the materials and percentages used have varied.

II. Materials and Equipment

The requisite solutions (suspensions) are made up as follows: To 1000 gm. of "S" brand sodium silicate, enough water is added to make 1000 cc. of solution. Thus, for all practical purposes, 1 cc. of solution is equivalent to 1 gm. of "S" brand silicate, and 1 cc. of solution, therefore, is equal to 0.05% of the clay in a slip that contains 2000 gm. of clay.

The barium carbonate suspension is made by adding to 500 gm. of $BaCO_3$ enough water to make 1000 cc. of suspension. Thus 1 cc. of the barium suspension is equivalent to 0.5 gm. of carbonate or to 0.025% of the clay in 2000 gm. of clay slip.

The advantage of these solutions is that they are convenient to handle and allow the reagents to be added in the desired extremely small amounts. Dilution also greatly retards the setting up of the silicate.

The equipment used included (1) a small $^1/_{30}$-h. p. Lightnin mixer; (2) a 10-cc. pipette; (3) a 100-cc. graduate; (4) a stopwatch; (5) a Mariotte-type open-top, cylindrical brass viscosimeter, the diameter of the tube being 4.5 cm., the altitude 15.5 cm., and the diameter of the orifice 3 mm.; (6) various assorted buckets, cups, and pans; (7) equipment for specific gravity determinations; and (8) balances.

III. Procedure

The viscosity of a slip is measured by the time required for 100 cc. of slip to flow from the viscosimeter, falling 10 cm. before it reaches the top of the graduate. The time elapsed is measured to the nearest 0.2 second.

The procedure of this test is in two parts, namely, the effect of the use of (1) barium carbonate and (2) sodium silicate.

(1) Effect of Barium Carbonate

(1) Determine the moisture content of the clay to be tested. (2) Weigh out an amount of the sample equivalent to 2000 gm. of dry clay. (3) Calculate the amount of water necessary to make a slip of the specific gravity ordinarily used in production. (It was found that 2255 cc. of water are necessary to change 2000 gm. of dry clay to a specific gravity of 1.411, which is the specific gravity used in the plant of the writer. The water included in the clay therefore is subtracted from 2255 cc., which gives the net amount of water to be added. A

* Presented at the Autumn Meeting of the Materials and Equipment and White Wares Divisions, Uniontown, Pa., September 14, 1940. Received September 16, 1940.

trial amount of 500 gm., deflocculated to a thin slip, should be run to check the specific gravity before proceeding with the original 2000-gm. test.) (4) Add 4 gm. of barium carbonate (0.2%) to the water and blunge thoroughly. (This amount of barium is suitable when Jernigan ball clay is used, but it will vary widely with different clays. The optimum amount can be ascertained only by experiment.) (5) Add the clay slowly while blunging, keeping the resulting slip liquid with silicate of soda solution and in a sluggish state at all times. (6) Tabulate the foregoing data and start adding 0.4 cc. or 0.01% of barium carbonate at a time, being sure to blunge for three minutes after each addition; make the barium additions up to 1% to ascertain the effect of excess of barium. (7) Make viscosity determinations after each addition of carbonate suspension. (8) Tabulate all of the data and put it in graph form from the time the slip is liquid enough to test the viscosity until maximum deflocculation is reached. By using the viscosimeter and the specific gravity described, the minimum viscosity to obtain a completely deflocculated ball clay slip is 5.5 to 6.0 seconds.

The final specific gravity should vary not more than 0.005; the limits of the test in the writer's plant vary from 1.406 to 1.416 specific gravity.

(2) Effect of Sodium Silicate

(1) Add barium carbonate to the water in optimum amount (as determined previously) before any clay is added. (2) Add the clay described before, using the sodium silicate solution to keep the slip liquid up to the last addition of clay. The slip must be well on the sluggish side and of a homogeneous nature before the addition of more silicate is begun; 0.20 cc. or 0.01% of silicate is added each time. After each addition, the slip must be blunged for three minutes before viscosity determinations are attempted. Additions are continued well past the point of maximum deflocculation. The data are tabulated in Table I and plotted as outlined for barium carbonate.

The specific gravity was held at 1.411 ± 0.003 in all ball clay slips except for the Kentucky Old Mine No. 4, which was tested at 1.442 (±0.003) so that its curve would not fall so close to the M. & M. English ball clay and cause confusion. All of the china clay slips were run at a specific gravity of 1.550 (±0.003).

IV. Results and Discussion

The results of the tests are shown numerically in Table I and graphically in Figs. 1 to 4.

The curves in Fig. 1 show strikingly that the amount of salts present in Jernigan ball clay is in direct proportion to the length of time the clay has been mined and that, within the limits of experimental error, the silicate curves are identical. This seems to indicate that the amount of salts present in the clay has no effect on the amount of sodium silicate necessary, provided the correct amounts of barium carbonate are added at all times. These curves also show that, except for the varying salt problem, the Jernigan ball clay is consistent in its properties.

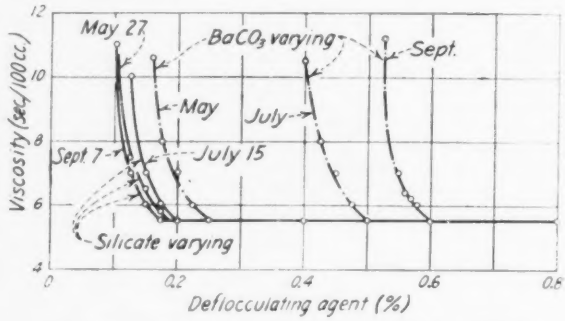

FIG. 1.—Jernigan ball clay (comparison for 1940).

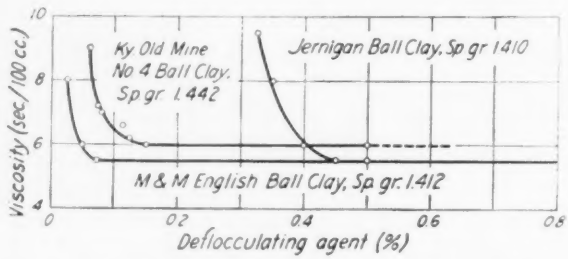
Ky Old Mine No 4 Ball Clay, Sp gr 1.442
Jernigan Ball Clay, Sp gr 1.410
M & M English Ball Clay, Sp gr 1.412
Viscosity (sec./100 cc.)
Deflocculating agent (%)

FIG. 2.—Effect of varying barium carbonate (comparison for 1940).

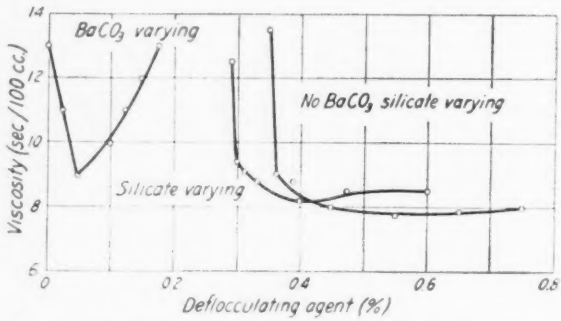

FIG. 3.—M. & M. No. 44 English china clay (June, 1940).

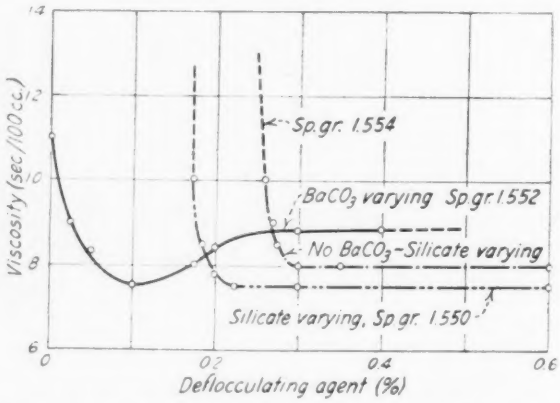

FIG. 4.—M. & M. No. 27 Georgia kaolin (June, 1940).

Earhart* has offered an explanation for the increase in adsorbed salts with the length of time after the clay is mined. When the clay is first mined, according to Earhart, it contains appreciable quantities of iron pyrite, which is oxidized to iron sulfate when it is exposed to the air and moisture. This, then, may be the main offender in the clay. If this theory is correct, when the clay is aged after it is mined, it should require increasing amounts of barium carbonate as the length of the aging period increases. The writer has found this to be unfailingly true.

To confirm this hypothesis, clays known to be low in salts, such as Moore and Munger English ball clay and Old Mine No. 4, were aged and tested. After an aging

* W. H. Earhart, ceramic engineer, Eljer Company.

TABLE I

(A) Jernigan ball clay (received May 27, 1940)

$BaCO_3$ varies (%)	0.150	0.175	0.200	0.225	0.250	0.500	0.800	
Viscosity (sec.)	Thick	8.0	7.0	6.0	5.5	5.5	5.5	
Na_2SiO_3	Constant at 0.5%							
Na_2SiO_3 varies (%)	0.100	0.125	0.150	0.175	0.300	0.400	0.500	0.600
Viscosity (sec.)	Thick	7.5	6.5	5.5	5.5	5.5	5.5	5.5
$BaCO_3$	Constant at 0.250%							

(B) Jernigan ball clay (received July 15, 1940)

$BaCO_3$ varies (%)	0.400	0.425	0.450	0.475	0.500	0.600	0.800	
Viscosity (sec.)	Thick	8.0	7.0	6.0	5.5	5.5	5.5	
Na_2SiO_3	Constant at 0.6%							
Na_2SiO_3 varies (%)	0.100	0.150	0.175	0.200	0.600	0.800		
Viscosity (sec.)	Thick	7.0	6.0	5.5	5.5	5.5		
$BaCO_3$	Constant at 0.480%							

(C) Jernigan ball clay (received September 7, 1940)

$BaCO_3$ varies (%)	0.525	0.550	0.560	0.570	0.580	0.600	0.800	
Viscosity (sec.)	Thick	7.0	6.4	6.2	6.0	5.5	5.5	
Na_2SiO_3	Constant at 0.91%							
Na_2SiO_3 varies (%)	0.100	0.125	0.150	0.175	0.200	0.800		
Viscosity (sec.)	Thick	7.0	6.0	5.8	5.5	5.5		
$BaCO_3$	Constant at 0.600%							

(D) M. & M. No. 44 English china clay (received June, 1940)

$BaCO_3$ varies (%)	0.000	0.025	0.050	0.100	0.125	0.150	0.175	
Viscosity (sec.)	13.0	11.0	9.0	10.0	11.0	12.0	13.0	
Na_2SiO_3	Constant at 0.367%							
Na_2SiO_3 varies (%)	0.290	0.300	0.310	0.330	0.400	0.475	0.600	
Viscosity (sec.)	12.5	9.4	9.0	8.8	8.2	8.5	8.5	
$BaCO_3$	Constant at 0.05%							
Na_2SiO_3 varies (%)	0.350	0.360	0.390	0.450	0.550	0.650	0.750	
Viscosity (sec.)	13.5	9.0	8.8	8.0	7.8	7.9	8.0	
$BaCO_3$	None							

(E) M. & M. No. 27 Georgia kaolin (received June, 1940)

$BaCO_3$ varies (%)	0.000	0.025	0.050	0.100	0.180	0.200	0.300	0.400
Viscosity (sec.)	11.0	9.0	8.3	7.5	8.0	8.4	8.8	8.9
Na_2SiO_3	Constant at 0.267%							
Na_2SiO_3 varies (%)	0.175	0.178	0.200	0.300	0.600			
Viscosity (sec.)	10.0	8.5	7.8	7.5	7.5			
$BaCO_3$	Constant at 0.10%							
Na_2SiO_3 varies (%)	0.260	0.280	0.300	0.350	0.600			
Viscosity (sec.)	10.0	8.5	8.0	8.0	8.0			
$BaCO_3$	None							

(F) Jernigan ball clay (received August 5, 1940)

$BaCO_3$ varies (%)	0.325	0.350	0.400	0.450	0.500	0.800		
Viscosity (sec.)	9.5	8.0	6.0	5.5	5.5	5.5		
Na_2SiO_3	Constant at 0.55%							

(G) Kentucky Old Mine No. 4 ball clay

$BaCO_3$ varies (%)	0.060	0.075	0.080	0.110	0.125	0.150	0.400	0.500
Viscosity (sec.)	9.0	7.2	7.0	6.6	6.2	6.0	6.0	6.0
Na_2SiO_3	Constant at 0.478%							

(H) M. & M. English ball clay

$BaCO_3$ varies (%)	0.025	0.050	0.075	0.450	0.500
Viscosity (sec.)	8.0	6.0	5.5	5.5	5.5

period of three years, they behaved in much the same manner as did the Jernigan ball clays, but they did not require as much barium carbonate. When tests were run on these same clays, unaged, minute amounts of carbonate had only an inhibiting effect, which indicated that the salt content was exceedingly low and proved that in all of the ball clays tested the aging of the clay is an important factor in determining the amount of barium carbonate required for neutralization. These data are shown in Fig. 2.

Figure 3 shows the results obtained when the test was run on an English china clay. The viscosity with varying amounts of barium carbonate reaches a low point at 9.0 seconds when 0.05% of barium is present. With further additions, the viscosity increases rapidly, which shows that only a small percentage of salts is present. The ascension of the curve is caused by the inhibiting effect of the carbonate on the silicate. When this amount of barium was used in another test and the quantity of silicate was varied, the viscosity dropped rapidly for a time, reaching a minimum at 0.400% and then beginning to rise beyond this point. This would indicate that too much barium was present or that some unfamiliar reaction was taking place. When a test was run without barium carbonate and the amount of silicate was varied, the viscosity dropped normally up to the addition of 0.550% and then began to rise again. This rise cannot be explained by the inhibiting effect of barium, but apparently it is caused by the same reaction as before. The main thought gained from this figure is that this clay is exceedingly free from salts.

Figure 4 shows curves for M. & M. No. 27 Georgia kaolin. The minimum viscosity of this clay is lower than the English clay, showing that it is more susceptible to the action of silicate. The fact that a lower viscosity is obtained when barium carbonate is added than without barium proves that this clay carries salts, although not in as high a percentage as do the ball clays. The thickening effect of an excess of sodium silicate is also absent. In the experience of the writer, this thickening, in general, is confined to clays which have large or medium large percentages of fine particles; the coarser the china clay, the more pronounced is the action of silicate.

V. Conclusions

The results of this test permit the following conclusions: (1) Jernigan ball clay carries large and varying quantities of adsorbed salts; (2) the quantity of salts present varies directly with the length of time the clay has been mined; (3) this variation may be plausibly explained to be caused by the oxidation of pyrite; (4) provided the correct amount of barium carbonate is added, there is practically no variation in the amount of silicate required for a particular clay; (5) English ball clays are not necessarily freer from salts than domestic clays; (6) English china clays seem to be freer from salts than the domestic china clays; and (7) the deflocculation test, as explained, affords a practical means of gaining valuable information about any clay and also provides an excellent control test for the ball clay that carries varying quantities of adsorbed salts.

The test is theoretically without error, that is, there are no inherent errors. Discrepancies between laboratory and plant practice may be placed on faulty technique. An accuracy of 1% is not at all unusual, and even greater exactness may be attained with sufficient care.

Acknowledgment

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Eljer Company
Ford City, Pennsylvania

SUMMARY OF SOME UNDERGRADUATE THESES FROM THE NEW YORK STATE COLLEGE OF CERAMICS*

By C. R. Amberg

Abstract

As a part of their senior study, students of the New York State College of Ceramics work out original theses under the direction of their professors. Because some of the theses on enamels have presented interesting results, the writer has prepared a summary of the methods used and of their results.

(I) "Comparison of Control Constants for Double and Single Nickel Salt Dips" by K. H. Sandmeyer: The effect of the variation of temperature, time of dips, concentration of dip, and pH value on the adherence of enamel to steel was studied.

(II) "Effect of Varying Composition on Abradability of Enamels" by S. C. Orr: A method was developed to study the abradability of glass; the amounts of feldspar, quartz, and borax were varied.

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(III) "Effect of Solution of Iron Oxide on Coefficient of Expansion of Enamels" by W. Paquin: Varying quantities of Fe_3O_4 were dissolved in enamel, and the coefficients of expansion were determined with the interferometer.

(IV) "Effect of Plasticity of Clays on Dry Film Strength of Enamels" by A. C. Francisco: A series of clays of varying plasticity was used; the comparative film strengths were determined by bending the dry specimens through varying angles before firing; and the tearing tendencies were studied.

(V) "Cleaning Metal Stock by the Tainton Nascent Sodium Process" by R. H. Hammell: The possibilities were investigated of cleaning enameling iron and steel before they were enameled.

(VI) "Enamels in Plated Silverware Design" by E. H. Wallace: A vitreous enamel that may be applied to plated silverware was developed.

I. Comparison of Control Constants for Double and Single Nickel Salt Dips (K. H. Sandmeyer)

The method of study in this thesis consisted of preparing sheets of 20-gauge enameling iron, 3 by 4 in. in size, by annealing and pickling. The specimens were rinsed, given the nickel dip, neutralized, dried, and coated with a commercial one-coat gray enamel. The thickness of coating was kept uniform by weighing the coated pieces after drying. After they were fired, the pieces were bent through an angle of 180° on a 1/4-in. radius, and the adherence was compared visually. Single nickel salts and double nickel salts were used, respectively, for the nickel dip. The temperature was varied from 60° to 71°C.; the time of dip was varied from 6 to 14 minutes. The single nickel salts varied in concentration from 2 to 4 ounces per gallon and the double salts from 3 to 6 ounces per gallon, that is, from 0.45 to 0.90 ounce of nickel per gallon for each salt.

The pH value was varied from 5.6 to 6.2 by additions of boric acid and ammonia. The variables were changed one at a time, and the best values from each preceding experiment were used in successive trials. All of the possible combinations of the variables were not tried, but the results show the trends produced by changing the variables. The best combination of variables for the single nickel salt was found to be an 8-minute dip at 60°C. with the solution concentration of 2 ounces per gallon and the pH value at 6. For the double nickel salts, the best combination found was a 10-minute dip at 71°C., with the solution concentration of 3 ounces per gallon and the pH value at 6.

The trends are summarized as follows: (1) With single nickel salts, the adherence decreased as the temperature was increased from 60° to 71°C., and with double nickel salts, the adherence increased as the temperature was changed from 60° to 71°C. (2) With a change in the time of the dip, optimum adherence was found at 8 minutes for single nickel salts and at 10 minutes for double nickel salts of the same nickel concentration; the adherence decreased with longer or shorter exposure. (3) With both double and single nickel salts, the adherence decreased as the nickel concentration was increased from 0.45 to 0.9 ounce per gallon. (4) The optimum value for pH was found to be 6 for both types of salt, and the adherence decreased markedly with the increase or the decrease in pH.

II. Effect of Varying Composition on Abradability of Enamels (S. C. Orr)

The method used in this study was developed by S. R. Scholes to study the abradability of glass (this method has never been published). The apparatus consists of a 12-in. grinding lap. Mounted above the lap with close clearance is a 3-in. diameter rotating chuck to hold the rod specimens of the test material; the center of rotation for the chuck is offset $3^1/_2$ in. from that of the grinding lap. A suspension of potters' flint and a small amount of clay, used as an abrasive, was fed to the center of the lap at a uniform rate. Rods of the enamel loaded with lead caps were subjected to grinding for a constant period of time. The following formula was developed to compensate for small differences in the weight of the rods and for the variations in diameter:

$$K = \frac{L}{\sqrt{l \times d}}.$$

Where K = abradability constant.
L = loss in weight.
l = weight of rod and lead cap.
d = diameter of rod.

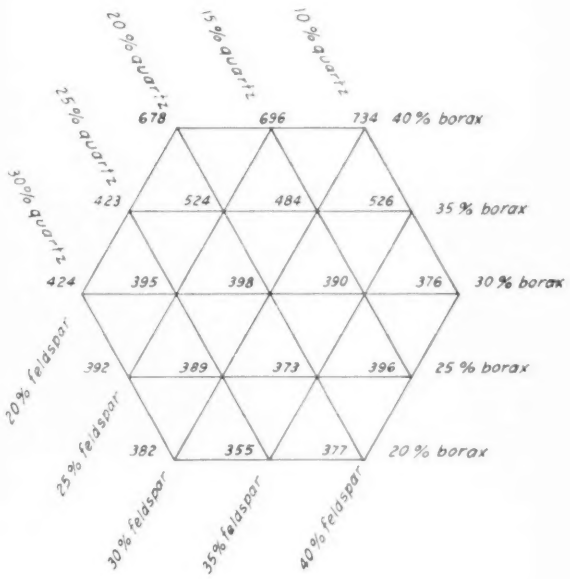

FIG. 1.—Values. $K \times 10^3$.

The principal difficulty was encountered in making the rods from the frits. This was accomplished, however, by casting the rods in preheated, 3-piece molds of electrode graphite.

The compositions investigated were quartz 10 to 30, feldspar 20 to 40, borax 20 to 40, soda ash 5, niter 4, and cryolite 11%.

The compositions are indicated in Fig. 1, and the abradability constant for each is given. The results show that borax is the principal factor in changing the abradability, which increases with increased borax content. An increase in borax at the expense of quartz increases the abradability more than a corresponding increase of borax with less feldspar.

There may be differences in the results obtained by this method from those obtained by the Porcelain Enamel Institute test for abrasion resistance, but it is evident that the method permits a comparison of the ease with which enamels of different composition are abraded.

III. Effect of Solution of Iron Oxide on Coefficient of Expansion of Enamels (W. Paquin)

The measurement of many properties of enamels on the specimens of enamel not applied to iron have been frequently and perhaps justly criticized. One such property is coefficient of expansion. The Mayer and Havas factor for Fe_2O_3 is 4×10^{-7}, which indicates that it should increase the expansion of an average enamel. Factors for FeO and Fe_3O_4 are not given by the Mayer and Havas tables.

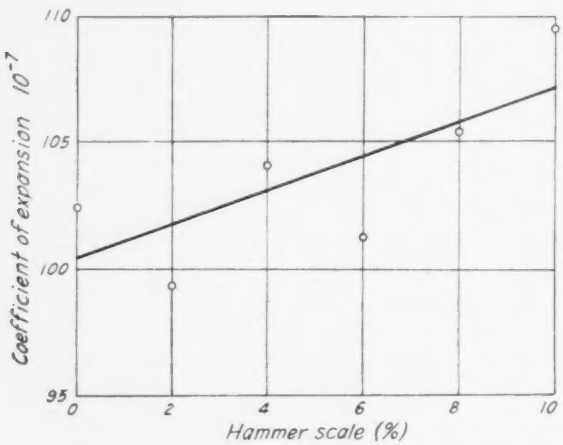

FIG. 2.

Hammer scale was produced in this work by oxidizing the enameling iron and was added in varying quantities to an enamel ground coat. The frits were smelted to complete fusion, cooled in the crucible, and the expansions of the enamel glasses were determined by the interferometer method.[1]

The results, which are shown in Table I, were not entirely satisfactory. Inhomogeneity in the enamel smelts may possibly account for some of the variations, but if the results are plotted as shown in Fig. 2, a trend toward an increase in coefficient of expansion with an increase in Fe_3O_4 is evident. On the basis of the smooth curve shown in Fig. 2, the factor for Fe_3O_4 would be 5.3×10^{-7} as compared with 4×10^{-7} for Fe_2O_3. The accuracy of the figures is questionable, but the tendency of dissolved iron to increase the coefficient of expansion of enamel is demonstrated. This fact probably is part of the answer to the question as to why enamels must be fired in an oxidizing atmosphere to secure adherence.

TABLE I

Hammer scale (%)	Avg. linear coefficient of expansion	Temp. range (°C.)
0	103.8×10^{-7}	31–356
2	99.0	33–361
4	104.3	35–365
6	101.5	28–362
8	105.5	34–350
10	109.7	36–368

IV. Effect of Plasticity of Clays on Dry Film Strength of Enamels (A. C. Francisco)

Six clays of variable plasticity were selected for study, all of which could be used in enamel ground coats without producing serious defects. The plasticity of the clays was not measured as such but was judged from related properties, namely, dry modulus of rupture and drying shrinkage. A commercial three-frit ground coat was ground to a fineness of 4 gm. on a 200-mesh screen, using The American Ceramic Society standard test for milled enamels, and it was adjusted to dip 32 gm. per sq. ft. The mill addition was clay 7, flint 3, and borax 0.75.

Dried, ground-coated plates were flexed or bent at a series of angles and then fired to bring out any cracking that may have occurred. Fine cracks, which healed in the firing, appeared at the edges of the sheet, but they seemed to bear no regular relationship to the clay. The angle of bend at which the enamel remained unhealed and at which bare steel was exposed was taken as the index to dry film strength.

The results are summarized in Table II.

TABLE II

(1) Clay No.; (2) modulus of rupture of clay in 1:1 clay-sand mix (lb./sq. in.); (3) angle of bend to expose steel (°); (4) volume shrinkage of clay-sand mix (%); (5) modulus of rupture of dry bars of enamel (lb./sq. in.)

(1)	(2)	(3)	(4)	(5)
1	22.1	9	9	50.3
2	33.9	11	17.5	31.3
4	110.0	12	18.2	33.2
3	150.0	13	30.8	46.9
5	228.0	17	35.5	75.1
6	250.0	19	50.1	110.5
Vallendar	No data	12	No data	68.7

The angle of bend necessary to expose the steel permanently bears a direct relation to the modulus of rupture and to the volume shrinkage of the clay-sand bars.

[1] G. E. Merritt, "Interference Method of Measuring Thermal Expansion," *Bur. Stand. Jour. Research*, **10** [1] 59–76 (1933); R.P. 515; *Ceram. Abs.*, **12** [3] 129 (1933).

In the case of clay No. 1, the modulus of rupture of the dry enamel bar seems to fall out of line, but the others check well.

V. Cleaning Metal Stock by the Tainton Nascent Sodium Process (R. H. Hammell)

The point of particular interest about this thesis is the method used. No markedly superior surface for enameling is obtained by the Tainton process as compared with the common methods of cleaning, but the results are good and the process itself has economic possibilities.

In the method used in the steel industry to clean steel for galvanizing, a bath of molten caustic soda at 500°C. is placed in a steel tank. The steel to be cleaned is made the cathode of a 6-volt direct current; a nickel anode is used because it stands up well in the bath. A current density of 2 to $2^1/_2$ amperes per sq. in. of sheet steel is used. The steel is left in the bath for $1^1/_2$ to 2 minutes and washed in hot water or first in a hot caustic solution and then in hot water. The direct current results in nascent sodium being liberated in contact with the steel.

The process is claimed to remove oil of any kind as well as dirt, scale, and even carbon and phosphorus from the surface layer, leaving pure metal on the surface of the sheet. This metal should have less tendency to rust if the steel is stored after cleaning.

In the present work, mineral and vegetable oils were smeared on the steel to be cleaned; enameling iron and also an enameling steel of higher carbon content were used. It was found that by this process the mineral or vegetable oils from the steel were removed as well as all traces of scale, the surface of the iron was silvery after cleaning, and there was evidence of an etching on those steels which had a higher carbon content.

After the metal was cleaned, a commercial ground coat was applied, and its adherence was tested by means of a dropping ball. Metal sheets, cleaned by alkali cleanser and by pickling, were run simultaneously for comparison.

Good adherence was found on the enameling iron whether it was cleaned by the Tainton process or by the alkali cleanser and pickling. The steel with a higher carbon content showed slightly better adherence when the Tainton process was used.

Sheets of either steel showed no rusting after storage for five days, and they produced equally satisfactory ground coats when they were enameled.

The particular advantage of the process seems to be that (1) it substitutes one 2-minute dip in the molten caustic for the cleanser, pickle bath, and neutralizer of the usual process; (2) it eliminates acid fumes; (3) it permits the use of drawing compounds that contain mineral oils; and (4) it produces a surface on the metal that is resistant to rusting.

One possible criticism is that the etching effect of the acid pickling is eliminated. With the mechanical etching on modern enameling iron, however, this may not be important. Some etching seems to be obtained by the removal of carbon from the steel by the caustic, but this is slight except for steels of appreciable carbon content.

(1941)

VI. Enamels in Plated Silverware Design (E. H. Wallace)

The possibility of using a vitreous enamel in place of an organic enamel in the depressed designs on plated silverware was investigated. The problems involved were peculiar because of the low temperature at which the enamel must mature. Too high a temperature causes the silver plate to blister and it also softens the nickel-silver base metal from which the ware is produced. Serious softening of the base metal starts at 1120°F. The enamel must resist thermal shock and have good adherence as well as a reasonable resistance to the acids and alkalis encountered in service.

Low-temperature cast-iron enamels, copper enamels, and jewelry enamels were tried. None of the cast-iron or copper enamels proved to have maturing temperatures sufficiently low. Five jewelry enamel batches were tried, but these were abandoned either because of a too high maturing temperature, too low acid resistance, or poor resistance to thermal shock. All of the jewelry enamels were rather simple in composition, composed chiefly of alkalis, lead oxide, boric oxide, and silica. The amount of silica seemed to be the most critical for, if the silica content were sufficiently low to get a satisfactory maturing temperature, the enamel had poor resistance to acids; a silica content sufficiently high to produce a reasonable resistance to acid rendered the enamel too refractory.

The problem was finally solved by the lowering of fusion temperature that results from complicating the batch. Small amounts of lithium, beryllium, barium, lime, zinc, and alumina were introduced. Titanium was also substituted for part of the silica. The final enamel composition was as follows: *Frit*, SiO_2 29.3, Al_2O_3 0.3, TiO_2 7.8, PbO 36.6, BaO 1.2, ZnO 0.6, CaO 0.4, BeO 0.2, K_2O 13.9, Na_2O 2.4, Li_2O 0.2, B_2O_3 6.8, and F_2 0.3%; and the *mill*, frit 100 and bentonite 1.

The bentonite was used to avoid an increase in the refractoriness caused by larger additions of clay. The mill batch was ground wet to a fineness of 0.1 gm. on a 325-mesh screen using The American Ceramic Society standard test for milled enamels. The fineness was necessary in order to apply the enamel satisfactorily in the depressed design. The application consisted of painting the enamel into the design. After it was dried, the excess dry enamel was rubbed off on typewriter paper. Too coarse an enamel resulted in the patches of the enamel tearing out in the rubbing process.

The enamel may be matured to a good gloss at 1090°F.; its adherence to the silver is good and it has good resistance to thermal shock; in fact, it could be dropped into cold water directly from the enameling furnace without crazing. No attack was found when the enamel was left overnight in vinegar or in contact with a sliced lemon. A 15-minute treatment by 10% of citric acid at 90°F. attacked the enamel but it did not entirely destroy the gloss. A pencil mark could be removed by a dry cloth with some difficulty. The enamel was uninjured during an overnight treatment with a 1% solution of NaOH, soapwater, or tea, and

thus it could be said to have reasonable resistance to the treatment it would receive in service.

A peculiarity of enamel that is applied to silver is its tendency to dissolve the silver during firing. This results in a faint yellow color, which makes it impossible to obtain colorless or pure white enamels. Commercial enamel stains, however, completely masked the faint yellow, and no difficulty was encountered in the use of those stains which are suitable for a lead-bearing enamel. A small increase in maturing temperature was noticed, which depends on the amount and the nature of the stain, but an adequate amount of stain could be introduced without exceeding the limit of 1120°F.

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COLLOIDAL MIXTURES AS BATCHES FOR GLASSMELTING*

By F. de Körösy

Abstract

A process is described in which the components of a glass batch are precipitated together or a colloidal mixed precipitate of some of the components with a solution of the remainder of the components is evaporated to dryness. The glass batches prepared by this method melted in less time and at a lower temperature than were chemically identical batches that were mixed from powdered components. The method is particularly useful for hard and highly refractory types of glasses.

I. Introduction

Extremely hard glasses need a high temperature and prolonged heating for melting. This involves a considerable loss of heat, and it is often necessary to use expensive, highly refractory crucibles. It is important, therefore, that the temperature and duration of the melting be reduced.

In the normal procedure, the ingredients of the batch are ground to a fine powder and are mixed mechanically before melting. Finer grain sizes facilitate reactions and insure melting in a shorter time; therefore, for extremely refractory glasses, the use of precipitated silica was recommended. To obtain the maximum thoroughness in mixing, the components were precipitated together or a colloidal mixed precipitate of some of the components was prepared with a solution of the other components and evaporated to dryness. The fact that hydrated SiO_2 and $Al(OH)_3$ form colloidal precipitates in water made it possible to insure colloidal mixing. A quasimolecular subdivision and mixing of the components was thus obtained. Whereas the components, in the ordinary batches, melt one after the other in succession of their melting points and gradually dissolve the most refractory ingredients, these colloidal batches are practically as homogeneous as the glass itself. Their point of fusion is equal to the melting point of the latter, that is, always below the melting point of the refractory components. The losses by evaporation are minimized and the composition of the glass is as near that of the batch as is technically possible.

II. Experiments Made

Experiments were carried out mainly on a glass composed of 83.5% of SiO_2, 12.0% of B_2O_3, and 4.5% of Al_2O_3. A 1.5 kg. sodium water-glass solution (29% SiO_2), with twice its amount of water, was mixed with a solution of 111 gm. of $AlCl_3 \cdot 6H_2O$ in about one liter of water; the latter was poured into the water-glass solution in a large porcelain dish and mixed thoroughly the entire time.

Concentrated hydrochloric acid was previously added to the aluminum chloride solution in a quantity not quite sufficient to neutralize the water glass. Sufficient hydrochloric acid was carefully added to the milky precipitated mixed gel of SiO_2 and $Al(OH)_3$ to keep the mass acid while mixing. Ammonia was then added until the reaction was alkaline again so that no alumina should remain in solution. The precipitate was washed onto a large filter with warm NH_3 water until the chlorine reaction disappeared. The precipitate was a creamy white jelly which could stand for weeks without change and contained about 79.6% water. A mixture of 1.33 kg. of this jelly and a solution of 66 gm. of $B(OH)_3$ in 300 cc. of hot water was prepared and was heated on a sand bath until it was completely dry.

A chemically identical batch was prepared by mixing 83.5 parts of precipitated silica, 6.9 parts of $Al(OH)_3$, and 21.3 parts of $B(OH)_3$. When heated in a small thermalit gas furnace at 1450° to 1500°C. for three hours, the precipitated batch melted to a glass full of bubbles, whereas the dry-mixed batch gave no glass at all, but only a white, opaque "frit."

These same batches were melted in ZrO_2 crucibles of about 200-cc. capacity in a gas-oxygen furnace at a temperature so high that most of the sillimanite lining at the bottom of the furnace melted away. After 2.5 hours at nearly 1600°C., the temperature rose for 1.5 hours to about 1850°C. Both samples were melted, but they were full of bubbles; the dry-mixed batch glass, however, contained undissolved "stony" particles even after this extreme heat treatment.†

Glass similar to Supremax, which contains 60% of SiO_2, 5% of B_2O_3, 4.5% of CaO, 10% of MgO, and

* Received March 8, 1940.

† The main technical problem is how to remove the bubbles from the glass. A vacuum furnace could be used, but even then the temperature and duration of the melting process can be reduced with colloidal batches.

20.5% of Al_2O_3 and which softens at 920°C., was mixed by the precipitating method. The batch was prepared by mixing 2070 gm. of water-glass solution (600 gm. of SiO_2), 313 gm. of $Al(OH)_3$ in hydrochloric acid, and a solution of 89 gm. of $CaCl_2$. The precipitate was made alkaline with NH_3 and was washed with warm NH_3 water for two days until it was free from chlorine. One hundred grams of MgO were dissolved in hydrochloric acid, and a hot solution of 61 gm. of $B(OH)_3$ was mixed with the pure gel mixture. The whole mixture was made alkaline with NH_3 and dried on a sand bath. (A parallel batch was prepared at the same time as a powder mixture from quartz flour, $B(OH)_3$, $CaCO_3$, MgO, and $Al(OH)_3$.)

Both batches were melted in ZrO_2 crucibles at the same time. The temperature rose in four hours to 1500°C. and remained at 1530°C. for the next three hours. The precipitated batch gave a perfect glass, whereas the dry-mix batch contained undissolved grains.

The practical value of this process depends on whether the economy in heat, refractory crucibles, and furnace material makes it worth while to treat the ingredients of the batch in this rather complicated chemical manner. Certainly the most refractory and expensive glasses would be best suited for this method.

III. Summary

In order to mix the components of glass batches as intimately as possible, a method was developed to co-precipitate and (or) co-evaporate its components out of solutions. Batches thus prepared melted at a lower temperature and in a shorter time than chemically identical batches mixed from powdered components. The method promises to be useful in the manufacture of highly refractory glasses.

Acknowledgment

The experiments were done in the research laboratory and glass factory of the United Incandescent Lamp Co., Ujpest, Hungary. The author wishes to express his gratitude to the Company for permission to publish this paper and to the colleagues in the glass factory for their valuable help.

BUDAPEST, HUNGARY

CERAMIC HISTORY

JAMES MACMATH SMITH, PRESIDENT OF SHENANGO POTTERY COMPANY*

The history of the Shenango Pottery is one of constant pioneering—long dreary months of discouragement, financial bogs that threatened to swallow up the little plant, then the first step on solid ground, and finally, over the years, a steady surge upward.

The New Castle China Company was organized in 1901, and a six-kiln plant was built on the present location of the Shenango Pottery Company. The officers of this Company were David C. Wallace, president; Frank E. Davis, secretary and treasurer; and directors, A. C. Hoyt, Charles H. Johnson, and John H. Preston. The plant, which manufactured vitrified hotelware and dinnerware for private homes, was closed in 1905.

The Shenango China Company was also organized in 1901 with the following officers: Eugene N. Baer, president; Edwin F. Norris, vice-president; P. E. Whittaker, secretary; E. E. McGill, treasurer; and directors, Captain M. S. Marquis, Andrew Fleckenstein, William E. Wallace, Elmer Phillips, and Charles A. Phillips. This plant, located on Emery Street, began the manufacture of semi-vitreous hotel and dinnerware and employed approximately 150 people. The Company, in 1905, became involved in financial difficulty, and a receiver was appointed. A new organization was effected, and a charter was taken out under the name of the Shenango Pottery Company. The officers and directors were Captain M. S. Marquis, president; Charles C. Robinson, vice-president; W. E. Wallace, treasurer; F. E. Wallace, secretary; and directors, Andrew Fleckenstein, E. E. McGill, E. F. Norris, and Elmer I. Phillips.

The going was still rough, and in 1908 the Company was again in financial difficulty. Three of the directors put in a substantial amount of cash, but in April, 1909, this money was gone and an entire new group took over the property. The officers were James MacMath Smith, president and treasurer; Rufus C. Patterson, vice-president and treasurer; and directors, Edward W. Beadel, W. A. Shipler, and John H. Clapp.

The new organization seemed to be the answer to the puzzle of nine years, and the Company slowly began to get established in the industry. The plant of the New Castle China Company was purchased in 1912, and the machinery and equipment of the Shenango Pottery Company moved from Emery Street.

These changes were completed in March, 1913, and the plant was about ready to get under way when the flood occurred. The plant was covered with three feet of the Shenango River flood waters, and it was May, 1913, before this damage was repaired.

The hard luck that had dogged the steps of the Company, however, was apparently over, or perhaps it might be better to say that the Company was now headed by a man who would not quit trying, James MacMath Smith. Since 1913, the Shenango Pottery Company has advanced every year. The plant has been expanded year by year, improvements have been made, and new ways have been sought to turn out ware of high quality.

In 1936, William Haviland, president of the famous Theodore Haviland potteries of Limoges, France, came to the United States to investigate the possibilities of manufacturing Haviland ware in this country. The high duties

* From *New Castle, Pa., News*, March 30, 1940.

and mounting costs made it almost impossible to continue manufacturing in France for the American markets. (A story of Theodore Haviland and the history of this Company was published in *The Bulletin*, **18** [8] 312–13 (1939).)

In New Castle, Mr. Haviland looked over the Shenango plant, saw the high caliber of workmen employed, and made his decision. Haviland china was to be manufactured in New Castle by the Shenango Pottery Company, and the Haviland ware that is seen today in the markets of the United States is made in New Castle, Pennsylvania.

Twelve acres of plant, 1200 employees, 10,000 tons of material used in one year, 60,000 dozens of ware turned out in every two-week period—these are some of the dramatic figures back of this immense plant that spreads out along the river for which the chinaware is named, the Shenango.

The Shenango Pottery is the lengthened shadow of one man, James MacMath Smith. He it was who believed in the future of the plant back in the days when the clouds were dark; he was the impelling force that kept fighting when the odds were almost insuperable. Today his faith is more than justified, for the Shenango Pottery stands as a monument to his courage and ingenuity and to the men and women who operate the plant.

The present officers and directors of the Company are James MacMath Smith, Sr., president and treasurer; Charles W. Read, James K. Love, and Jonathan Higgins, vice-presidents; and James MacMath Smith, Jr., assistant treasurer.

Born in 1862

In 1845, a Mrs. Ten Broeck arrived in New Castle with the first piano in that part of the country, and she supported her three children by teaching music. Her oldest daughter, Louisa, married James MacMath Smith, a sewing-machine agent; their three children were Sophie, James MacMath, born in 1862, and Bright.

James, who left school to support his mother, worked first for the Penn Coal Company, digging and hauling coal. About 1885, he entered the hardware store of Kirk and Dickson and eventually became a partner in the hardware business under the firm name of Kirk, Hutton, and Smith (for the story of C. J. Kirk and of this Company, see *The Bulletin*, **16** [7] 309–11 (1937)).

In 1900, James MacMath Smith married Frances Agnew, from Sewickley, Pa., an art teacher in the public schools. They have two children, James, Jr., and Alice (Mrs. Jonathan Higgins).

ACTIVITIES OF THE SOCIETY

THE PRESIDENT'S ADDRESS*

By John L. Carruthers

Today, we formally begin the activities of the Forty-Third Annual Meeting of The American Ceramic Society. As we look over the various items in the program, such as the scientific and technical papers and the extra-curricular affairs arranged for our education and entertainment, we could easily say that, in all respects, this is to be a normal Meeting of The Society. However, as we hear the various conversations in the lobbies, as we hear inquiries for Jim or Joe, busy at the factory or in training camp, and as we read the foreign and national news, we realize that in many respects this is not a normal Meeting in the ordinary sense of the word. We find that the spirit, the thought, and the tone are quite different. There is everywhere a sense of wonderment as to where the activities of the times are leading us.

Defense Keynote

Today, defense is the keynote of many, if not all, of our national, state, civic, industrial, educational, scientific, and personal activities. We find ourselves surrounded by intensive military expansion with all of its ramifications, which is affecting or will soon affect in one way or another the lives of all of us and the institutions with which we are concerned.

Basically, it is in the defense of these institutions and of our way of living, thinking, and doing, that we as a country are making such efforts. It is not my intention to define, discuss, or outline defense along military, political, or business viewpoints. That job is for others. Any institution, however, if it is to survive, must be concerned with a program of defense, and so it is with The American Ceramic Society.

Man has ever had to defend his possessions and activities against others, and this likewise holds true for industrial, business, and educational enterprises. It was discovered early, however, that one of the best methods of defense in any contest, be it war, sport, or business, is that of promoting a real offense. This in turn requires ability and preparedness through knowledge and training. Therefore in The American Ceramic Society we have our defensive problems.

I like to think of The American Ceramic Society as a vital agency in the defense program of that which we may properly call "the Art of Ceramics" as represented by our various ceramic industries. The work of The Society is to help the offense of the industry by aiding in the improvement of this Art.

The Art of Ceramics

The Art of Doing Things normally precedes the science related thereto. Even today, with all of our scientific knowledge and technical development, we must still rely to a large extent on the developed arts and technical skill to carry out the findings of the laboratory and to make them real. And so it should be realized that all of the scientific

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and technological developments described before our Society and others of its kind are primarily for the advancement of the Art, be it Ceramics, Metallurgy, Education, or Agriculture.

If the scientific and technical information presented to this Society is properly applied to the "Art of Ceramics," then we have progress, and the industry is defending or protecting itself in maintaining and bettering itself. In the affairs of The Society we must likewise have our defensive and offensive operations, and I want to report on such activities as well as to present several thoughts for future planning.

During the past year, as you may have noted in the published reports in *The Bulletin*, The Society has increased in size and resources. It is significant that, in spite of all the turmoil in Asia and Europe, the foreign membership and subscriptions are essentially unaffected, and so we may report that the past year has been a successful one and that we are now practically on a pre-depression basis in all respects.

Locations of Annual Meetings

A new development of the past year has been the establishment of a policy with respect to the locations of the Annual Meetings of The Society. A Special Committee formed to study the problem made its report to the Board of Trustees at its winter meeting in Pittsburgh and the recommendations were adopted. This report was published in the January, 1941, issue of *The Bulletin*, p. 29.

Briefly, this policy states that in each decade at least five Annual Meetings shall be held in the so-called Central District, which is the area within a radius of approximately 150 miles from the geographical center of our membership (Coshocton, Ohio). In the other five years, there shall be two Meetings in the Eastern Seaboard District and one each in the Southern, Western, and North Central Districts. The policy also states that not more than two consecutive Meetings may be held outside the Central District.

This plan enables members in every district, except those in the Far West District, to participate actively in the Meetings of The Society with minimum expense and travel during a ten-year period.

The Special Committee also classified the various cities in each district according to hotel accommodations suitable for such Meetings. In a way, members in certain midwestern cities will have an additional burden to carry, but this burden will be one of work only inasmuch as it is the policy of The Society that each Meeting shall pay its own way.

This policy enables the Board of Trustees to do some long-time planning and it eliminates a lot of lost motion that has occurred in the campaigning of various cities to be chosen as a Meeting place. Following out this policy, the Trustees have decided that the Forty-Fourth Annual Meeting will be held in Cincinnati in 1942 and the Forty-Fifth Annual Meeting will be held in Pittsburgh in 1943.

Structure of The Society

Perhaps the structure of The Society seems somewhat complicated as we review the make-up consisting of Members, Fellows, and Divisions, and the Classes, namely, the Institute of Ceramic Engineers and the Ceramic Educational Council. These various groupings, however, with their different interests, enable our members to perform the various functions of The Society and to participate in those phases of ceramic activity with which they are most concerned. As the activities of the Fellows, the Divisions, and the Classes expand so will The Society expand. The accomplishments of the Divisions and Classes are being reflected today in the growth of The Society.

Color Symposium

A significant development at this Meeting is the Color Symposium which has been organized by an appointed delegation of ten members of The Society to the Inter-Society Color Council. Such symposia are sponsored normally by one or more of the Divisions of The Society. It is a somewhat new type of program for our Meetings, but it is one that should be of real interest to many of our members, and more programs of this nature should be planned in the future.

Standardization of Rules

Following the re-codifying of the Constitution, By-Laws, and Rules of The Society several years ago, each Division was asked to formulate and to approve a new set of Rules, consistent with those of The Society and cast on a standard pattern. The Rules of the Fellows, of both Classes, and of three of the Divisions have been thus set up. The Rules of three other Divisions are ready for approval. This action provides for simpler and better government in our various groups. This work, under the jurisdiction of the Rules Committee, is to be extended next to the simplification and standardization of the Rules of the Local Sections and of the Student Branches.

Technical, Practical, and Review Papers

It is believed at this time that we shall probably have the normal amount of contributions of scientific and technical papers for next year. The changing conditions of the times, however, will mean that each group of The Society must be ready and willing to adjust itself to possible changes in policy and plan. We shall need to be alert if we are to maintain and extend our activities.

During the last decade, there has apparently been a marked increase in the number of scientific papers presented before The Society and a reduction, at least in percentage, of papers dealing with the interpretation and application of the fundamentals of science relating to materials, products, equipment, and processes. Although The Society wants more scientific papers, it is believed that there should also be a concerted effort on the part of the Divisions for more papers that interpret the science and describe its application so that the vital information will reach the man in the plant.

We must recognize that there are members in this Society with many different interests. We have scientists, technologists, engineers, artists, plant executives, teachers, salesmen, production men, and others. If the findings of science and technology and the developments of the scientists, technologists, engineers, and others are to accomplish their purpose, it is necessary to have more papers of a type which some might call "practical papers." It is also desirable at times to publish papers that are essentially reviews of the workings of different processes and equipment and that serve to bring us up to date on such subjects.

It is believed that the objectives of The Society could be extended, that industry would benefit, and that many more persons would be interested in The Society if the programs should be intensified along such lines.

Service Offered by The Society

There are many requests for service or financial support made on The Society from Divisions, Classes, Universities, Museums, Art Groups, and others. Generally every request has merit. Whenever it is feasible or possible, the General Secretary and his staff and the officers of The Society render all possible service, subject to the limitations of their time and the resources of The Society, for such purposes. These services and support merit every consideration, yet if the membership wants such service increased, wants new types of service added, and wants The Society to contribute financially to worth-while projects, it must provide the personnel and finances to do so. Such an increase in activities requires an increase in Personal and Corporation Membership.

There is not one ceramic plant in this country or abroad or one ceramic engineer, technical man, or production executive who has not greatly benefited from the work of this Society and will not continue to so benefit in the future. It should therefore be the personal responsibility of each of us who contributes to The Society in papers, time, and money to see that all who benefit therefrom should help to carry the load in all ways and to permit us to extend our services. We would be doing them a service as well as a real service for ourselves. Every effort along this line will be reflected in the advancement of all phases of the ceramic industry.

Membership Advantages

Our entire membership should be bringing continually to the attention of all those who are qualified, but who are not members, the advantages to be gained by membership as well as their responsibility to participate in the affairs of The Society which they enjoy and profit therefrom but do not support.

Efforts along this line will assist the ceramic industry to progress, which in turn means that all of us advance. If we believe in the purposes of The Society, we should work for them and promote them.

Before closing, I want to express my appreciation to Ross C. Purdy and each member of his staff for the fine cooperation that has been extended to me in carrying out the duties of the Presidency. It has been a real privilege to have had the close association with the General Office that I have had during the past year. If each of us will expend the energy, enthusiasm, and spirit on the affairs of The Society during the time we have available as do those in the General Office, we may be sure that The Society is defending its position and is growing and prospering.

In the year that lies ahead of us, it is certain that we shall have many new problems. We may be sure that we shall always be actively concerned with a defense program of one sort or another. Many of the factories in the ceramic industry will be directly or indirectly participating in the National Defense Program. Others will be busy furnishing goods to the expanding market that present conditions have created. In every case, there is always the need to defend the industry, which is best done by progress along technical and business lines. If the various research laboratories, the engineers in the field, and others will continue their work, we may be sure that the Ceramic Industry is not only helping to defend but is defending itself in the best possible manner.

Therefore, in closing, it is hoped that all who are here now and others may be at the Meeting next year and that the reports of scientific, technical, and industrial progress to be made at that time will show that the Ceramic Industry is keenly aware of its responsibility in defending itself and promoting the general welfare of the country by reason of the advances that will have been made.

REPORT OF COMMITTEE ON RESEARCH FOR 1940–1941

A. A. Wells, Homer Laughlin China Company, Newell, West Virginia, is Chairman of the Committee on Research of The American Ceramic Society. The Division representatives of this Committee for 1940–1941 are *Art*, H. F. Bopp; *Enamel*, R. J. Whitesell; *Glass*, N. W. Taylor; *Materials and Equipment*, J. F. McMahon; *Refractories*, D. W. Ross; *Structural Clay Products*, Frederick Heath, Jr.; and *White Wares*, J. R. Beam.

Enamel

A large number of broad investigations are being carried on in the field of enamels both in pure and applied science. Researches for the basic principles of adherence and suspension have continued as well as investigations to obtain greater covering power, thinner enamels and ground coats, and greater mechanical strength. Current studies on the mechanics of enamel suspension and adherence,[3],* fundamentals of ceramic colors and opacity,[5] and methods of application and the use of new materials are illustrative.

It has been pointed out that when molybdenum dioxide and antimony trioxide are milled into a clear enamel base they produce adherence comparable to the typical cobalt ground-coat enamels. Soluble molybdenum trioxide plus Sb_2O_3 likewise produce adherence but cause drying problems; other compounds, such as antimonyl molybdate or barium antimony molybdate, may also be used in place of Sb_2O_3 plus MoO_3.

The effect of particle size on the reflectance of thin semi-transparent layers, such as enamels, has been studied by using mixtures that contain opacifying particles of definite sizes in an oil of known index of refraction.[5] The coefficient of scatter per unit surface decreases slowly as the particle size decreases. The particle size and index of refraction have a decided effect on the reflectance, which may be obtained from an enamel for a given amount of opacifier. The reflectance increases as the difference between the index of refraction of the opacifier and the surrounding medium is increased. For large particles, the scattering power varies as the total surface of the opacifying material.

Increased opacity is obtained by extremely fine milling because of the excellent dispersion of the opacifiers.[5] Increased reflectance is due to the increased interfaces of the opacifier and frit and to the increase in the number and the decrease in the size of the gas bubbles. The latter factor is important because of the greater relative difference in the indices of refraction of the gas and of the enamel constituents. Extremely fine-milled enamels mature at a

* Superscript numbers in parentheses indicate reference to the laboratory which is conducting a specific research test, see p. 174.

lower temperature than coarser fractions, and they are less easily scratched because of the smaller bubbles in the structure.

With the use of X-ray and microscopic technique, a detailed examination was made of the effect of smelting time and temperature on the crystalline material causing opacity in typical superopaque antimony enamels.[5] Although the crystalline antimony compound causing opacity in such enamels dissolves slowly at smelting temperatures, there is a decided increase in the particle size of the opacifier particles as the time of smelting is increased.

The reactions which take place when a typical superopaque antimony enamel is smelted have been studied[5] (*a*) by determining the thermal effects which occur during the smelting of the raw batch and (*b*) by investigating the reactions which produce these effects. Up to 500°F., the dehydration of the borax is the chief reaction; between 500° and 800°F., the first liquid develops with the melting of the soda niter. Most of the reactions, however, take place from 800° to 1300°F.; soda niter and sodium silicofluoride are decomposed, and the antimony trioxide is oxidized. Considerable glass is formed above 1300°F., and the enamel gradually becomes more uniform.

When cerium oxide is added to the mill charge, it is an excellent opacifier for enamels, apparently better than tin oxide on a pound-for-pound basis[3]; a study of the solubility of tin oxide in enamels is also in progress.[5] The solubility of a zirconium oxide opacifier in enamel glasses and its effect on the refractive index and fusibility of the glass have been reported.[5] An increase in the alumina, zinc oxide, and calcium oxide content in the glass causes a decided decrease in the solubility of the zirconium oxide opacifier. The fusion temperatures of the enamels are raised by the solution of zirconium oxide. A general study of opacity is under way.[5]

Various studies have related enamel properties to composition, namely, (*a*) the effect of varying the alumina content on the properties of typical vitreous enamels,[23] (*b*) variations in the compositions of wet-process, leadless cast-iron enamels in the development of better enamels,[5] (*c*) the physical and chemical properties and microstructure of a continuous mill-enameled sheet steel in relation to the enamel process, and (*d*) the thermal expansion and refractoriness of typical commercial enamels.[23]

Tests show a decided improvement in strength for enameled specimens over that of stock before enameling.[5] An increase in the thickness of the enamel also increases the strength within limits. The effect on the lighter gauges is greater than on the heavy gauges, and the strength is greater when the enamel is under compression than under tension.

At the Porcelain Enamel Institute Forum held in 1940, infrared drying, fine grinding of colors, and test methods were considered and symposia were held on the use of clays and nepheline syenite.

The development of standard tests for enamels and enameled products has been continued.[23] Tentative tests have been published for abrasion resistance and chipping resistance (impact and torsion tests). Other tests being studied are color variations and the scratch and gouge tests (hardness).

The relation of defects in enamel coatings to hydrogen in steel[22] and the effect of hydrogen as a function of time, temperature, and impurities in steel have been demonstrated. Blistering and boiling action over carbide areas in steel are due principally to hydrogen that associates with carbon. Steel enameling stock contains quantities of hydrogen which may effuse during firing to cause or aggravate such phenomena as "boiling," "primary boiling," "reboiling," "blistering," and "bubbling."

Scumming has received attention. The sulfate type of scumming has been claimed to be caused by sulfates either in the enamel materials or in the atmosphere to which the ware is exposed. Nonsulfate types of scums are usually caused by a combination of factors, which include underfiring, excess water vapor in the furnace atmosphere, fineness of grinding, and mill additions, especially clays and opacifiers.

Phosphorus has been found to reduce the sag of laboratory-prepared enameling stock to a marked degree.[22] The most effective range of phosphorus is from 0.10 to 0.15%, and killed steels are superior to rimmed steels in their sag resistance. Phosphorus appears to have no significant influence on common enameling defects, and it has no marked effect on the adherence of the enamel in amounts of less than 0.40%.

The spectrographic analysis of enamel frits has received attention, and the method has been in laboratory use long enough to provide data on its practical advantages. The elements most commonly encountered are Na, K, Ca, F, B, Sb, Zr, Ti, Al, Si, and O. Although these elements are difficult to analyze chemically, it is possible, with the spectroscope, to analyze any combination of these elements within two days and to maintain a practical accuracy of ±10% of the amount contained.

Research problems on enamels suggested for work or continued experimentation include (1) research on pickling; (2) development of a simple test to determine cleanliness of enamel iron; (3) research on drawing compounds; (4) the correlation of grain size with milling variables; (5) a bibliography on ball-mill effect on particle size; (6) the solubility of acid-resistant frits in mill liquor; (7) the measurement of the film strength of a bisque coat on enamels in the dry state; (8) the firing of vitreous enamel in direct-fired furnaces; (9) the effect of smelting antimony in frit; (10) research on a new stronger flux for enamels; and (11) research on reboiling.

Various other types of enamel research under way or recently completed include (1) the application of thin, uniform ground coats by electrical deposition; (2) studies on the relation of thickness and methods of application of enamels[5]; (3) the conductivity and pH of enamel slips[3]; (4) the weather resistance of vitreous-enameled iron structural units[23]; (5) autoclave tests on enamels[5]; (6) sheet-steel ground coats; (7) the solubility of iron oxide in sheet-iron ground coats; (8) the effect of lithia in enamels[5]; (9) the effect of various electrolytes on the acid resistance, "set," and defects of acid-resisting enamels; and (10) quantitative determinations of the effect of lithia to replace soda on the various properties of vitreous enamel.[13]

Glass

The Glass Division of The American Ceramic Society as a group is not sponsoring or doing any research, although certain other organizations are quite active.

Committee C-14 of the American Society for Testing Materials is continuing the development of improved testing methods for chemical durability, strength, and chemical analysis. The Glass Container Association is supporting fundamental studies on mechanical properties and on inhomogeneities in glass as well as X-ray studies and fracture photography. Much confidential research is in progress by some glass companies, whereas others are doing practically nothing.

The fundamental problem of immiscibility of glass should receive attention on a broader basis as little is known from the scientific point of view. An attempt has been made to apply the ideas of crystal chemistry to the problem of immiscibility in glass systems.[4] Miscibility is favored by the tendency of the network-forming cations, Si, B, and P, to bond with all available oxygens in the melt. Immiscibility is favored in compositions which do not allow the other cations, such as Na^+ and Ca^{++}, to be properly surrounded by unsaturated oxygens. The importance of this effect may be related to the valence and size of the cation. The well-known facts of miscibility and immiscibility in glass systems should be correlated with the present-day concepts of structural silicate chemistry.

There has been continued work on the relation of composition of glass to various properties. A review of the existing literature of the relation of density and refractive index to the composition of glass has been made.[16] A study has been made of the relation between chemical composition of the potash-lime-silica glasses and their densities, indices of refraction, and thermal expansion.[23] The

composition and physical properties of special glasses have been investigated.[23] The most significant work at the present time is that of establishing relations between the specific refraction of glass-forming oxides and the glasses made from such oxides. The data indicate that specific refractions are functions of the periodic arrangement of the chemical elements. The viscosities of a number of soda-boric oxide-silica glasses were approximately determined in the temperature range from 900° to 1500°F. by noting the deformation of small glass rods.[5] The melting rate of soda-lime-silica glasses as influenced by composition and the effect of minor constituents has been studied. The properties of phosphate glasses are being determined.[1] The elastic and viscous properties of several potash-silica glasses in the annealing range of temperature are being investigated.[1] A publication deals with glass melts in the system ZrO_2–Al_2O_3–SiO_2 and TiO_2–Al_2O_3–SiO_2.[5] The elastic and dielectric properties of glass have been studied.[1]

The results obtained measuring the surface tension of glasses by a modified dipping cylinder method agree well with published data obtained by the maximum bubble-pressure method. The temperature coefficient of surface tension is approximately −0.02 dyne per cm. per °C. The surface tension of glass at a particular temperature may be represented as a linear function of composition on a mol fraction basis.

The power factor measured on a series of soda-lime-silica glasses decreases with increasing frequency and increases markedly with an increase in the Na_2O content.[19] Starting with a base glass with a composition of Na_2O 17.4, CaO 10.1, and SiO_2 72.5%, to which 0.030 gram-atom of various elements in the form of their oxides is added, an increase in power factor is produced by additions of Zr, Na, and Al oxides; a decrease is produced by additions of the oxides of Si, V, Zn, Mg, B, Ti, Co, Ca, Ce, Ni, Mn, Fe, Ba, Pb, Li, and K.

In a study of the relation of electrical conductivity to the chemical composition of glass,[5] an increase in resistance was produced by additions of MnO, ZnO, B_2O_3, Fe_2O_3, BaO, PbO, TiO_2, and K_2O, the resistances increasing in this order. A decreased resistance was produced by Na_2O, CaO, and Al_2O_3 additions.

In an investigation of the effect of heat-treatment on the dielectric constants of some soda-borosilicate glasses, an attempt is being made to explore the structure of glass by means of dielectric constants.[13] Densities, refractive indices, and dielectric constants of eighteen glasses of the system Na_2O–B_2O_3–SiO_2 have been measured for a number of different conditions of heat-treatment below the softening point. An attempt is also being made to interpret the processes which occur when a glass is cooled from the fluid condition.

A study is in process on the properties of glasses in which bismuth trioxide is a major component.[13]

The phase-equilibrium relations in the system Na_2O·-$2SiO_2$–$BaO·2SiO_2$ have been studied by means of the quenching method.[13] Refractive indices have also been measured, using the microscopic immersion method.

Phase equilibria in the system MgO–B_2O_3 are being investigated.[1] The solid solution phenomena in dicalcium silicate are receiving attention.[1]

In a study of the effect of alumina on the devitrification of sodium oxide-dolomite lime-silica glasses, it was found that dolomite-containing glasses always have lower liquidus temperatures than glasses that contain equal percentages of calcite; when tridymite is the primary phase, a substitution of Na_2O, Al_2O_3, or CaO·MgO for SiO_2 decreases the liquidus temperature. Any replacement of CaO·MgO by SiO_2, Na_2O, or Al_2O_3 lowers the liquidus temperature of glasses in which diopside is the primary phase.

An investigation of the rate of diffusion of helium at temperatures from 300° to 500°C. through four glasses of widely different composition showed that the heat-treatment of the glass in each case had a marked effect on the permeability to helium. Helium appears to work its way through small holes of atomic size in the network of atoms which constitute the glass structure.[1]

Chemical durability tests on glasses have been carried out in different laboratories. The results obtained (Owens-Illinois Glass Co.) by tests on crushed samples and bottle surfaces on a variety of commercial glass-bottle compositions show the difficulties encountered in the attempt to correlate accelerated tests with the actual performance of the bottles toward various solutions under service conditions. Some results indicate that the value of accelerated tests conducted with distilled water as a leaching medium is questionable as an aid to predict the resistance of various glass compositions to neutral solutions at room temperature. Accelerated tests conducted with distilled water as the initial leaching medium do not measure the resistance of a glass to a neutral solution but rather to an alkaline solution, the concentration of which increases at different rates for different compositions of glasses tested.

Acid tests at room temperature agree well with those at higher temperatures. The relative resistance of glass bottles, shown by accelerated tests with water, roughly parallels the relative resistances appearing in room-temperature storage of unbuffered, neutral materials only if the various amounts of extraction are approximately the same at both temperatures. The tendency of bottles to produce flakes or insoluble matter in alkaline solutions bears no direct relation to the amount of soluble matter extracted by such solutions.

Bottle surface tests with alcoholic solutions of various strengths and with distilled water show that corrosion decreases with increasing alcoholic concentration. The results show no relation that will hold for all glass bottle compositions between extraction values with distilled water in any accelerated test and extraction values or the tendency to form flakes in neutral alcoholic solutions.

The powder method for the measurement of chemical durability of glass has been studied.[5] The pH meter has been found a useful tool, which may well take the place of titration for the estimation of small amounts of extracted alkali in studying the durability of glasses.[8] A study of the solubility of glasses in acid and alkaline solutions that is under way [23] includes cooperative work between The American Ceramic Society and the American Society for Testing Materials, with special reference to methods for determining the relative solubility of glasses. Tests to determine the relative solubility of domestic chemical glassware are in progress.[23]

A series of melts of soda-lime-silica glass cullet in contact with various chemical elements was made to determine by observation the extent of the reaction between metal and glass.[5] Using an atmosphere of hydrogen gas, various colors were produced by Cu, Ag, Au, Se, C, S, and Zr. Black fogs resulted from melts containing Ba, Cr, or V; gray or black fogs with reddish zones resulted from Mg, Ca, Ti, Mn, Si, and Al; and only slight attack was shown by Fe, Ni, Zn, Cd, Bi, Sn, Pb, Mo, and W.

A new method to determine selenium in glass comprises fusion of the sample with sodium carbonate, dissolution of the melt in sulfuric acid, distillation of the selenium as selenium tetrabromide from a sulfuric-hydrobromic acid solution, and titration of the distilled selenium by the iodide-thiosulfate method.[22] Analytical methods have been developed which shorten the time required to determine many of the constituents found in glass.

Some suggested research problems on glass include (1) the radiation and absorption characteristics of molten glass at various temperatures; (2) the temperature and flow effect on glass (Corhart interphase); (3) the volatility of soda and other oxides from glass at various temperatures; and (4) a rapid method for the determination of cord varieties.

Other investigations on glass include (1) the fading of color in commercial glass in service[5]; (2) the heat-treatment and "striking" of colored glasses[1]; (3) the effect of heat-treatment on the color of gold ruby glass[5]; (4) the development of ruby-colored glasses[22]; (5) vanadium as a glass colorant; (6) the decolorization of manganese and sulfur in glass with an application to the use of furnace slags[5]; (7) staining glasses with silver for a study of inhomogeneities[1, 5]; (8) the use of the sonic test to examine

glass[18]; (9) a study of the requirements for "fine annealing" borosilicate crown glass blanks, especially those having irregular shapes[23]; (10) the effects of lithia in glass[5]; (11) opal glasses[1]; (12) the use of caustic alkali in glass batches[5]; (13) the effect of currents in glass-melting tanks on the quality of ware; (14) tests on hollow glass building blocks (compressive and transverse strengths, thermal conductivity, and resistance to moisture penetration[23]); (15) the surface hardness of glass[6]; (16) standardization of tests to measure the degree of mixing obtained in glass batches (a study of the fundamental law governing mixing[8]); and (17) the beneficiation of Washington sand for glass.[7]

Refractories

Considerable work has been done and is being continued on superduty refractories and insulating brick. The development of the superduty brick is one of the outstanding accomplishments in refractory technology during recent years. These brick are highly resistant to spalling, afford excellent resistance to certain slags, have high load-carrying ability, and are practically stable in volume at high temperatures. They were first used in boiler-furnace service, but they are now in use in the piers and combustion chambers of enameling furnaces, the walls and roofs of frit furnaces, in glass tanks, pottery kilns, and in the steel industry in open-hearth and heating furnaces. The term "superduty" represents a class of fire-clay brick made from carefully selected clays under controlled production methods.

The American Refractories Institute maintains a multiple industrial fellowship for research work.[21] Various types of researches that have been made include (1) the chemical and physical properties of clays of various producing districts; (2) checker-brick for resisting alkaline slags; (3) the factors involved in the spalling of various types of refractories; (4) the properties of and test methods for plastic refractories and cold-set mortars; (5) the development of tests for insulating refractories; (6) the effect of chlorine, sulfur dioxide, and carbon monoxide on various refractories; (7) the effect of kiln atmosphere on the size of refractories; and (8) the influence of grinding and firing on the characteristics of silica brick and the proportioning of grain size in clay refractories. The careful control of grain size has become one of the more important steps in the manufacture of many varieties of refractory products.

Studies of used-lining failures indicate that some order of increase in lining life and associated decrease in maintenance cost might follow the use of special refractories in the critical parts of blast-furnace linings. Increased size and operating temperatures of blast-furnace stoves have imposed more severe conditions on refractories, which fact emphasizes the importance of the proper selection of refractories.

The effect of molten alumina on refractory brick has been studied to obtain an explanation of some of the brick failures in aluminum melting furnaces. A study of the brick has revealed that some failures are caused by the penetration of the aluminum into the brick accompanied by a reaction between the aluminum and the brick.

Magnesium orthosilicate has been claimed to be the most satisfactory high-temperature alkaline earth orthosilicate because it is physically stable, chemically inactive, and does not form other compounds with an excess of magnesia. Among the disadvantages of the use of forsterite are the facts that (1) MgO is replaced by CaO, SrO, and BaO, yielding a low-melting point or an unstable orthosilicate, and (2) the formation of forsterite is partially inhibited by P_2O_5, B_2O_3, and Cr_2O_3. Calcium orthosilicate and monticellite are useful components of refractories; merwinite, barium, and strontium orthosilicates, however, are not very satisfactory.

The satisfactory behavior of the forsteritic refractories manufactured from Pacific northwest olivine may be attributed to the high density obtained by grain-size control and to the proper addition of the conversion agents, chromite and magnesia.[7,24] It is claimed that excellent refractories may be made from this material. Work also has been done on North Carolina olivines.[2]

Properties of refractories prepared from aluminum, olivine, and magnesite have been studied.[8] Forsterite refractories, used on the roofs of copper anode or holding furnaces, have given three years of life as compared with several months formerly obtained from silica brick, and forsterite refractories of superior strength have been developed by adding 24% of magnesia to 76% of olivine. Refractories of still greater strength have been produced by a mixture composed of aluminum powder 4, magnesia 24, and olivine 72%.

The addition of aluminum metal powder to fire-clay–grog mixtures increases the strength of the fired brick as a result of an aluminothermic reaction between the metal and the silica in the clay and grog.[8] Because the reaction takes place at 930°C. and causes the temperature to rise rapidly, these refractories are heated only to 930°C. to produce hard, well-fired brick. Such products have a high load-carrying capacity at furnace temperatures and also a fair spalling resistance.

Silicon carbide kiln furniture is rapidly replacing fire-clay kiln furniture because it occupies less space in a kiln and is therefore more economical. By making this refractory stronger at furnace temperatures, thinner slabs may be used and more ware may be set in kilns. By adding 12% of aluminum powder to the raw batch, the strength at furnace temperature is increased by about 500%.[8]

A study has been made of the refractory properties of topaz, and the effect of heat-treatment on its chemical, physical, and mineralogical properties has been investigated.

The effect of water content and mixing time on properties of air-setting refractory mortars that contain sodium silicate has been investigated.[23] The relation was determined between the dry strength and the water content of an Ohio fire clay, a mix of the fire clay and grog, and the same mix containing 25% of a solution of sodium silicate. A study [13] of the mechanism of the hardening of clay-sodium silicate mixtures, such as those used in refractory cements, has shown that the hardening of these mixtures may be prevented by a preliminary treatment of the clay with nonprecipitating sodium ions, introduced as sodium carbonate, before mixing with sodium silicate. The effect of water content and mixing time on the properties of air-setting mortars that contain sodium silicate has been reported,[23] and work is being continued on the wet and dry types of air-setting refractory mortars.

Further research problems on refractories include (1) the elastic, plastic, and creep properties of refractories at several temperatures[23]; (2) laboratory tests of some ladle-lining refractories[5]; (3) the development of new tests to control the quality of refractories and to study their probable behavior in service[21]; (4) the spalling resistance of refractory materials at low and high temperatures[23]; (5) the viscosity-temperature characteristics of some coal-ash slags[5]; (6) the gas permeability of refractory and insulating brick between 25° and 300°C.[23]; (7) the effect of mineralizers on the underload refractoriness of some bodies[5]; (8) the properties of bonding material in some refractory bodies[5]; (9) the failure of boiler-furnace refractories[23]; (10) a study of Virginia kyanite in refractories[6]; (11) a study of the development of refractories from North Carolina olivines[2]; (12) the production of an insulating refractory from pyrophyllite[2]; (13) the thermal decomposition of topaz as a possible source of high aluminous material for refractory purposes[24]; (14) the development of unfired aluminous refractories from pyrophyllite[2]; (15) developments in insulating refractories [18]; (16) various problems on acid, basic, and neutral refractories[22]; (17) the deformation of insulating firebrick under load (no correlation was found to exist between the weight and the resistance to hot loading or between the cold crushing strength and the hot load-bearing capacity); and (18) the development of lightweight refractories.[8] By developing insulating brick which are refractory enough to be placed inside of furnaces, considerably less heat is utilized because less of the brickwork is heated.

Several studies which have been suggested are (1) the disintegration of refractories under modern atmospheric conditions in heat-treating furnaces; (2) the control and cause of after-expansion and after-shrinking in fire clays; and (3) the reduction of spalling of brick in rotary lime kilns.

Structural Ceramics

Problems pertaining to the manufacture and use of paving brick are the subject of fellowship work sponsored by the National Paving Brick Association.[18] Research is centered principally in an acceptance test investigation. An acceptance test road (a three-mile stretch on U. S. Route 23 in Delaware County, Ohio) is under study in an attempt to correlate the service of brick under modern traffic with the rattler test which was adopted in 1915. This project is a cooperation of the National Paving Brick Association, the Ohio Department of Highways, and the U. S. Public Roads Administration. The behavior of the brick, from sixteen different paving-brick plants, in the pavement is compared with the performance (individually and on the average) of representative samples in standard and modified tests of transverse strength, water absorption, and rattler loss. The road is in its second year of service but so far no conclusions have been drawn as to the adequacy of the present test methods. By a comparison of the laboratory and field results, the investigation is a search for a physical test which will accurately predict the serviceability of a paving brick under present-day traffic. The composition and application of brick joint fillers have been studied and certain bituminous compounds have been developed for this purpose.

The Glazed Brick and Tile Institute is sponsoring work on the properties of glazed brick units.[18] The Structural Clay Products Institute is doing work on small prefabricated sections of brick and tile. New means for the installation of tile are being studied.[13] The Brick Manufacturers Association is sponsoring work to improve the strength and other properties of Hudson River brick.[8] It has been found that the strength may be increased by (*a*) drying the brick more thoroughly before setting them in a kiln, (*b*) discontinuing the use of lime as a stiffening agent, (*c*) using dry ground clays as a stiffening agent, (*d*) stiffening the clay by partial drying or deairing, and (*e*) adding soda ash to the mixture. Studies are being continued on the fundamental characteristics of brick and mortar and their effect upon masonry construction.[4] The following factors will also be included: (*a*) the workability of mortars, (*b*) the experience record of structures, (*c*) the effect of weathering, and (*d*) the pore structure of brick.

Brick highly saturated with water during outdoor winter storage fail from freezing quicker than those not highly saturated.[8] The Hudson River soft-mud brick do not absorb and retain as much water as other brick and therefore should be more resistant to freezing. The influence of steam, hot water, deairing, wetting agents, and soda ash on some properties of New York shale and soft-mud brick is being studied. Certain clays used in the heavy clay products industry are difficult to work in extrusion machines and tend to crack and become weak after drying. The properties of such clays were found to be naturally benefited by the use of steam, hot water, deairing, wetting agents, and soda ash. Steam, together with soda ash, produces especially strong bodies.

The investigation of properties of floor brick and other products for which there are no A. S. T. M. specifications is under way to develop specifications for these materials.[23] Heat-transmission tests have been arranged for on cavity walls and on four types of hollow tile walls.

When glazed terra cotta is used for interior ware, it is subjected to the moisture of the air; the body expands and causes crazing if this expansion is too much.[8] Tests are being conducted to determine the degree of expansion of terra-cotta bodies and how it may be related to a standardized autoclave treatment.

A study has been made of the influence of the lime content of brick and on their ability to take zinc-green, yellow, tan, and brown glazes by vapor glazing.[8] A fellowship has been sponsored to investigate the use of mixtures of borax and salt and boric acid in salt glazing heavy clay products. This work has shown that better glazes may be produced by the use of boron compounds together with salt in salt glazing. The fundamental properties of the salt glaze are being determined[18]; an investigation is being conducted on the physical properties of glazed and zinc-flashed brick; and low-cost glazes for structural clay products are being studied.[23]

A survey of the manufacture of "lightweight products" (construction materials with a density of 30 to 60% of that obtained with customary methods of manufacture) has been made of all of the known processes.[18] They may be grouped as follows: (1) the use of large voids in the shape, (2) the inclusion of combustible material and (3) of materials which are removable by evaporation, solution, or sublimation, (4) the incorporation of natural or synthetic lightweight materials, (5) the formation of small cells during firing, and (6) the formation of small cells in the semifluid or plastic material before firing.

Suggested research on structural ceramics includes (1) research on glazed brick and tile; (2) the development of a satisfactory glaze for "lightweight" units; (3) ceramic glazes for tile unaffected by sulfur in clays; (4) the elimination of efflorescence due to soluble salts and the development of a rapid method to determine effloresing tendencies; (5) the development of the best atmosphere for various stages of brick firing; (6) the use of inert gases to fix color and to prevent reoxidation; (7) the development of permanent color in zinc-flashed, light-colored brick from red-firing shale; (8) the time, temperature, and circulation effect on the oxidation of clayware; (9) data on thermal and moisture volume changes in brick masonry; (10) correlation of thermal conductance and capacity with other brick properties; and (11) the effect of deairing of brick on certain properties.

Researches on structural ceramics under way or recently completed include (1) a study of the cause of disintegration of certain glazed structural units and the correction of this defect[18]; (2) a study of pore structure and its relation to the frost resistance of brick[23]; (3) the effect of deairing on the physical properties of structural clay products[23]; (4) the development of a technique to measure the sonic properties of certain structural products as an acceptance or inspection examination[18]; (5) a study of the internal structure of certain structural products[18]; (6) a fundamental study on structural plasters[22]; (7) the development of lightweight structural units using Virginia waste product[6]; (8) the development of a vitreous slip for a Nebraska brick clay[10]; (9) the use of agricultural waste materials to produce water-resisting insulating brick[10]; (10) an investigation of the suitability of North Carolina shales for mortar mix[2]; (11) a new method of precast brick-wall construction which permits waterproofing and insulation of a brick veneer attached to a steel frame[10]; and (12) an extensive research on mortars with the careful study of clay admixtures.[10]

Whiteware

The minutes of the meeting of the Whiteware Research Committee appeared in the February, 1941, issue of *The Bulletin* (abstracts of problems discussed were given in reference).

In a symposium on test methods at the O.C.I.A. fall meeting, simple tests for whiteware materials and products were considered. There is no standard acceptance test for such properties as the hardness and solubility of glazes and translucency and glaze fit. It has been suggested that an agency, sponsored possibly by The American Ceramic Society, be established to standardize on tests.

Because of the increasing emphasis on conservation of natural energy resources, attention has been directed toward electric firing for all types of ceramic ware.[24] The cost of electricity is still higher than that of gas or oil in all parts of the country except in those regions where government or municipal power programs are active. The results obtained by firing large sanitary ware and

masses of full-size brick, substantiated by theoretical calculations, have shown that (*a*) the heat radiated at incandescent temperatures is the major method of transmission, (*b*) the same (or faster) firing schedules may be maintained, and (*c*) commercial requirements for quality and uniformity of vitrification may be met easily if time is given for "soaking" or completing the reactions at maximum temperatures.

Based on the behavior of phosphates in silicate melts, a possible picture of the constitution of bone china bodies has been presented.[1] The characteristic features are the formation of fluor- and hydroxy-apatite as the chief constituents of the rigid framework and of a glass high in lime that has a higher refractive index than the glassy matrix of normal porcelain bodies. The translucency, the whiteness, and certain characteristic defects of bone china may be explained on this basis.

Studies are being conducted on the warpage of chinaware,[24] which is caused by (*a*) nonuniform shrinking during drying and firing, (*b*) handling in the damp deformable condition, and (*c*) irregular softening and support at the end of the vitrification period. A few prefired refractory supporting rings may be used to straighten the twisted bisque plates in a second firing and thus recover a portion of the high losses caused by warpage.

The effect of flint and feldspar subdivision on the properties of whiteware bodies has been further shown. Particle-size measurements on commercial flint and on feldspar indicate a considerable variation in grain-size distribution from shipment to shipment. Ball-milling of the slip provides a reduction chiefly in the particle size of nonplastics, and ware cast from such slip is more vitreous and possesses a decidedly more glassy and homogeneous fracture. The same results may be achieved in part by using finer-ground nonplastics directly in the blunged slip. A study is under way on the effect of particle size of talc and pyrophyllite on the properties of insulator bodies.[6]

The grain size of a body slip, especially the percentage finer than 1 micron, has been found to bear a fairly close relation to the casting rate of the slip when the condition of the slip is such as to produce a cast with the correct feel or degree of plasticity.[18] Other factors being equal, the lower the percentage finer than 1 micron, the higher the rate of cast. The pH of a casting slip does not change greatly with age up to 96 hours.

The effect of various catalysts on the conversion of quartz to cristobalite and tridymite at high temperatures has been studied.[1] Alkali oxides, which were found to be superior to all other substances, are effective in amounts of less than 0.1%. Acid oxides, such as B_2O_3 or P_2O_5, seem to have little or no value as catalysts for this inversion. Another investigation on the influence of mineralizers on the inversion of quartz is under way.[3]

Research on whiteware bodies includes (1) a study of the internal structure of ceramic bodies and the development of a technique to measure the sonic properties[18]; (2) the development of new bonds and methods of fabrication[22]; (3) the glassy phase[23]; (4) the effect of various temperatures and heating rates[23]; (5) the effect of oxidizing and reducing firing on the vitrification range (by firing the ware under reducing conditions, the vitrification range can be increased considerably and the maturing temperature can be reduced[8]); (6) a study of nepheline syenite in floor-tile bodies[6]; (7) the development of new electrical insulators[22]; (8) an investigation of the effect of topaz in electrical porcelain bodies[2]; (9) the production of spark plugs from fused mica[10]; (10) studies on the use of mica in various bodies[18, 23]; (11) length changes of clays and bodies during initial heating[23]; (12) the effect of a method of forming of specimens and firing treatment on properties of talc bodies[23]; and (13) the use of eutectic fluxes in vitreous whiteware.[3]

A new method to manufacture dental porcelain involves molds of vinyl acetate, an organic material resembling soft rubber.[18] The ingredients are sifted into the molds and the molds are vibrated slightly. The porcelain body contains no bond or plastic and depends on the forming for its unfired strength. Dentures are formed by pyroplastic pressing. The addition of a uranium salt to the body makes the teeth appear white and lustrous under artificial light as well as daylight.

Applications of dry mixing of ceramic bodies are increasing. New uses for dry-mixed bodies are being developed, and in several instances an improved body structure has been obtained. Applications in electrical refractories, specialties, and porcelain and in wall-tile production have been mentioned.

The effect of (*a*) the mixing time, (*b*) the order of the addition of ingredients in compounding the mixture, and (*c*) the use of sodium silicate and acetic acid in tempering water on the physical properties of an electrical porcelain body has been reported.

Work has continued on organic dispersing agents in casting slips to increase plaster mold life and to produce slips with other desirable properties. Synthetic dispersive agents, which may replace natural ethereal oils used in decorative processes, are receiving attention.[12] A Bartell cell is being used to measure the wettability of various ceramic materials, and the effect of organic agents on this property will be studied.[13] Data have been presented on the use of a synthetic organic agent, which consists of a neutralized, long-chain organic acid condensed with formaldehyde, as a plasticizing and binding agent. The use of alginates as substitutes for gums in the ceramic industry is being studied.[18] Polyvinyl alcohols have found some application as a result of their film-forming power and adhesiveness. Other investigations along these lines include (*a*) the effect of wetting agents on the properties of some plastic clay bodies[5]; (*b*) the substitution of bonds other than clays in the production of bodies[13]; and (*c*) the effect of some electrolytes on the drying properties of clays.[5]

Studies on glazes include (1) fundamental reactions of glaze constituents[23]; (2) reflectance measurements on glazes[5]; (3) lead glazes containing barium and those containing magnesium[5]; (4) the viscosity of some low-fire lead glazes[5]; (5) the control of consistency of glaze and similar slips[5]; (6) the use of a porcelain enamel frit for low-temperature pottery glazes[15]; (7) the volatilization of glaze constituents by spectrographic means[8]; and (8) the acid resistance of overglaze decalcomania.[3]

The present status of the PbO–Al_2O_3–SiO_2 phase-equilibria investigation indicates that it will be a very complex system.[23] The primary fields for the lead orthosilicate, the tetralead silicate, and one incongruently melting ternary compound have been established. The composition of this compound is believed to be $8PbO \cdot Al_2O_3 \cdot 4SiO_2$. It melts to form glass and the compound, $4PbO \cdot Al_2O_3 \cdot 2SiO_2$, which in turn melts incongruently to form glass and a compound, the composition of which has not yet been determined. Several other compounds have been identified by their indices, but their compositions are not established.

Work has been continued on eutectic fluxes and on aluminosilicate and borosilicate glasses.[3]

Various glaze-fit tests have been compared.[18] The ring test was found to be suitable for the qualitative measurement of glaze stress. The flat-plate test requires little equipment and it is rapid and quite accurate for two-fire glazes, but it is unsatisfactory for one-fire glazes. The tuning-fork test is satisfactory chiefly for research work. Glazes in moderate or higher compression increase considerably the flexural strength of glazed bodies; glazes in low compression or tension on these bodies decrease the flexural strength.

In an investigation to promote interfacial reaction to counteract crazing,[8] thin mineral layers were applied to biscuit vitreous and semivitreous whiteware bodies. These layers were subsequently coated with a glaze. A better glaze texture was obtained in certain cases as well as increased crazing resistance. A study of the interface of the matured body and glaze is in progress,[5] and another investigation is concerned with crystalline development at the body-glaze interface.[13] The effect of certain opacifiers on the crazing tendencies of certain glazes is being studied.[7]

An investigation has been made covering the moisture

expansion which occurred in a series of tile and dinnerware specimens after varying periods of storage and service and the relation of these values to the results of three autoclave tests of different severity.[23]

Porous whiteware bodies craze in the autoclave test when feldspar is used as a flux[8]; when talc is used, they pass the autoclave crazing test, but they have too short a temperature range between crazing and shivering; and when zircon is substituted for a portion of the talc or feldspar these defects are minimized.

The present work on colorants or that recently completed includes (1) the use of uranium oxide and vanadium oxide as ceramic colorants[3]; (2) the stabilization of the cobalt colorant[3]; (3) the development of a satisfactory black pigment for glazes and enamels in which the oxide of cobalt (an important component of currently produced stains) may be minimized or completely eliminated, thus materially reducing the cost of such stains[13]; (4) the use of titanium stains in hotel china bodies has caused trouble due to color variation (alumina and zirconium oxide extenders in the stain produce more uniform colors when they are fired under different conditions[8]); and (5) the effect of furnace atmosphere on the colors derived from chromium.[13] In (5), chromic oxide powder was heated in an electric furnace under controlled atmospheric conditions and the color of the resulting material was determined.

A committee from The American Ceramic Society is cooperating with the Inter-Society Color Council in an attempt to find what terms are used in talking about the colors of ceramic products and what meanings are attached to these terms. Definitions are being formulated for such terms as color comparison, checking, grading, and matching. Color terms rather than color names are being sought for such words as strong, deep, muddy, pale, shade, hue, tone, and color differences.

Photographic work, which has been developed in ceramics, is entirely the adaptation of photographic processes used in other fields. A general investigation should be made of the metallic salts, which are photochemical in nature and which at the same time produce color in ceramic applications. An investigation is under way on the application of trichromatic photography to ceramics, permitting permanent reproductions in full color.[13] This involves a considerable amount of manipulation along strictly photographic lines plus the determination of suitable light-sensitive metallic salts which will offer final ceramic color values on an additive basis.

Materials

The Nonmetals Division of the Bureau of Mines deals with problems of purification and the preparation for market of materials used in the ceramic industry.[24] These problems include the testing of products of beneficiated minerals to determine their suitability for ceramic use. The investigation of problems relating to national defense is emphasized, especially those raw materials formerly imported which can advantageously be supplied from domestic sources. Such problems include (*a*) the beneficiation and use of kyanite, clays, diatomite, etc., (*b*) methods of beneficiating impure domestic raw materials to make them commercially usable, and (*c*) the thermal decomposition of topaz as a possible source of a high aluminous material for refractory purposes.

The substitution of American for imported clays has received increasing attention (where this study has not as yet been done) owing to the present conditions in Europe. Although sufficient quantities of English clays are still coming to this country, some manufacturers of whiteware are anxious to develop bodies containing only American clays in case the supply is shut off. A symposium was held on this subject at the 1940 Annual Meeting (papers and discussions appeared in the August, 1940, *Bulletin*). Studies on the substitution of domestic clays, which have been carried out in various laboratories, are (1) a large number of casting slips made from American clays have been investigated to determine their suitability for use in large sanitary ware, and some valuable results have been obtained that should develop a demand for certain of the domestic clays tested[24]; (2) the deflocculating and casting properties of North Carolina kaolins in casting bodies have been found similar to those of English china clays[18]; (3) the substitution of American clays in whiteware bodies is being studied[8]; (4) the utilization of Georgia kaolin in ceramics[18]; (5) an investigation of specially processed North Carolina kaolin, Kamec, in different whiteware bodies[18]; (6) tests on 35 New York clays to determine the products they are best suited for[8]; and (7) Hudson River clays, used only in common brick, have been found suitable for use in some of the higher grade heavy clay products, such as roofing tile, quarry tile, and glazed brick.[8]

An evaluation of clays for all known uses has been worked on[24] to permit the classification of a particular clay into its possible use group. A detailed geologic map of the residual Alaskite kaolin deposits in the Spruce Pine area has been prepared which clearly shows the large tonnage of reserve kaolin. Of the clays tested, the North Carolina kaolins correspond most closely to the English kaolins in physical and chemical properties, but the improved methods of preparation show them to be finer grained, more plastic, and stronger than the English clays. White-firing bodies of considerable plasticity and strength may be obtained (without the use of ball clay) with plastic Florida kaolin, which approaches the ball clay in plastic properties but has a purer chemical composition.

The shales of the Pennsylvanian age in Illinois have been studied.[20] In mineral composition, these shales differ from each other chiefly in the relative abundance of the clay minerals and quartz, which gives a wide range in ceramic properties. Base-exchange capacity, a characteristic of the clay minerals, has a direct bearing on the unfired properties. The correlation, however, between base-exchange and unfired properties cannot be close unless all materials have exactly the same clay-mineral composition and the same exchangeable base is present in each material.

The effect of exchangeable bases on such properties of clays as torsion, transverse strength, and drying has received attention.[22] The workability of clays may be changed and governed to a large extent by base-exchange control. The absorption and transverse strength of clay bodies, both in the unfired and fired state, are influenced greatly by the nature of the exchangeable bases present on the surface of the clay particles. Plastic clays with high exchange capacity are affected more than nonplastic clays. Of the various common base forms studied, sodium-type clays require less water to give the same degree of stiffness, and their unfired and fired transverse strengths are high. Hydrogen clays require higher water content and have a greater porosity and lower transverse strength.

A study of the properties of kaolinite as a function of particle size shows that there is no fixed or simple relation between the apparent surface of kaolinite and the true or effective surface except in the finer fractions.[5] This is likewise true of the relation between the apparent surface and drying shrinkage, base-exchange capacity, and heat of wetting. The effective surface of kaolins may be estimated better from base-exchange capacities than from particle size.

When the clay minerals, illite and montmorillonite, are heated at various temperatures up to 1400°C., the changes which occur have been studied by using X-ray and optical determinations.[20]

A study on the use of bentonite has been published.[24] Flexible, greaseproof clay sheets can be made from bentonitic slips for corrosion-resistant containers and indestructible means of document recording.[4]

Studies have also been published covering staining of the common clay minerals as a rapid means of identification. This subject is currently a subject of much interest in economic petrography. The basis of the differentiation of the kaolinite group from the bentonites of the montmorillonite type is the ease with which a variation in staining hue is effected with bentonites but not with kaolinites.

Other investigations on clays include (1) the mineralogical and colloidal constitution of certain clay types[1]; (2)

the effect of anions on the colloidal properties of whiteware clays[1]; (3) values of heats of wetting of unfired and fired clays (these have been reported[5]); (4) ball clays[23]; (5) the use of the Brabender plastograph to study the usual types of clays[12]; (6) a fundamental study on overfiring of clays[22]; (7) some characteristics of Illinois pottery clay (this study shows three different types of thermal expansion as a result of the presence or absence of cristobalite and an intermediate[5]); (8) the properties of Illinois clays as mortar-mix materials[5]; (9) the analysis of high alumina clays by the thermal method and its usefulness in the control of raw materials[4]; (10) a rapid method to determine quartz in refractory clays; (11) the removal of iron mineral impurities from clays and sands (quantitative studies on the adsorption of certain new reagents[24]); (12) the effect of wetting agents on the slaking rate of clays[15]; (13) tests on the drying behavior of clays by new methods[8]; and (14) the decolorization of clay.[13] In (14), methods heretofore proposed for bleaching the off-white clays and allied earths are reviewed and examined. Instances of natural bleaching are enumerated and traced to the action of microorganisms in the soil. Various clays were treated with selected cultures, and conclusions are given as to the feasibility of improving certain types of clay by microbiological processes.

Froth flotation, electrophoresis, and electrodialysis as means of improving the quality of the clay have been under study.[24] Fundamental studies pertaining to the special characteristics and properties of clays as well as studies involving the base-exchange characteristics of various clays are under way. An apparatus, the eykometer, has been developed to measure the yield point of clay suspensions.

Froth flotation and agglomerate tabling have been applied to a considerable number of nonmetallic mineral mixtures to effect the concentration and beneficiation of these materials.[24] Usually classification by dry screening and frequently wet-desliming and surface-conditioning by attrition milling or chemical cleaning are applied before the actual flotation and tabling treatments. Feldspar-quartz-mica mixtures and combinations that occur as pegmatites or as granites have been tested. Methods for beneficiating feldspars have been installed, and a procedure has been developed in which the coarse feldspar is agglomerated and tabled and the fine feldspar is floated by lauryl amine hydrochloride and fluorine-bearing acids or salts in an acid circuit. Another flotation treatment employs hydrofluoric and hydrochloric acid for mineral surface conditioning. More extensive use of this type of treatment for separating feldspar and quartz for possible recovery of both constituents is anticipated and predicted.

The beneficiation of the feldspathic waste from a titanium mine near Roseland, Virginia, has been studied.[12] This waste, which is mainly sodic plagioclase, quartz, and an iron-bearing mineral, gedrite, contains about 5.3% of Fe_2O_3. By magnetic concentration, 73% of the feed is recovered in a feldspar-quartz mixture with an iron content of 0.81% of Fe_2O_3. Between 85 and 90% of the feldspar with an iron content of 0.41 to 0.52% is recovered from this product by agglomerate tabling and flotation.

Nepheline syenite has found commercial application in almost all types of pottery, enamel, and glass products.[18] The need for a more active flux when the more refractory clays are used has furthered its commercial utilization in the pottery industry. Nepheline syenite is used in enamel mixes as an ingredient of frits as well as a ground-coat mill addition; the low fusibility and high alumina content of nepheline syenite make it a desirable raw material for the glass industry.

Beryl has found use in bodies and glazes; in the body it adds resistance to thermal shock owing to its high heat conductivity, low coefficient of expansion, and greater strength. The substitution of beryl for feldspar in a glaze will harden the glaze. One of its most unique properties is to develop high-temperature chrome greens.

Beryllia has been in use for some time as a coating for filaments in lamps, for electrodes in electron tubes, and as a cathode heating element in radio tubes. It may also be used in electrical unit heaters in which the resistance wire is imbedded in the refractory and as a lining in coreless induction furnaces. Because it is much more resistant to thermal shock and less reactive with graphite than magnesia, it is particularly useful as a radiation shield around a graphite crucible.

Flotation studies on the beneficiation of spodumene have been made.[24] After the mineral surfaces are cleaned, spodumene may be froth-floated from associated minerals by the use of a number of different reagents; oleic acid was considered best. Spodumene and feldspar may be concentrated together, and the quartz in the rocks in question is rejected.

Vermiculite is the name of a group of micaceous, hydrated silicates which are the alteration products of micas. The coefficient of thermal conductivity of the vermiculite at Libby, Montana, varies between 0.26 and 0.35, the P. C. E. value is 11, and the coefficient of sound absorption varies from 0.34 to 0.58. The principal use has been as "loose-fill" insulation for dwellings and buildings, refrigerators, and furnaces. The development of lightweight concretes using North Carolina vermiculites is being studied.[2]

Research on the olivine obtained from two large deposits in Washington comprised a study of its properties and possible uses.[7, 24] The chief points investigated were (*a*) physical, chemical, and mineralogical properties; (*b*) the effect of chemical additions; (*c*) the development of the densest and most refractory body; (*d*) the manufacture of brick; (*e*) a comparison of these brick in P. C. E.; (*f*) spalling, load test, absorption, and resistance to basic slags with other brick; and (*g*) local use of olivine as a foundry sand. The mineralogical composition of North Carolina olivines is being determined.[2] The work at the Bureau of Mines includes an electric-furnace fusion study of olivine and a study of the MgO–SiO_2 system by electropetrological methods.[24] The forsterite–magnesia–silica system has been studied over a wide range of temperature. Another study on the development of refractories from North Carolina olivines is under way.[2]

Five years of work on the kyanite family of minerals, kyanite, sillimanite, andalusite, dumortierite, and mullite, are being prepared.[24] The important deposits, the work on beneficiation and the existing plants, and the high-temperature behavior of these materials are considered.

The rate at which North Carolina kyanite of various grain sizes decomposes into mullite and glass in the range 1350° to 1600°C. has been studied. The rate of inversion of kyanite at a given temperature varies with the degree of shattering produced in the fragments either by mechanical or thermal shock and, therefore, on the cross section of the individual cleavage fragments or fibers into which larger fragments may be reduced before the inversion temperature is reached.

The froth flotation of Virginia kyanite has yielded a concentration containing 93% of pure kyanite.[6] Studies have indicated that this mineral is of considerable value to the ceramic industries; its softening point is P. C. E. 36 to 37; and the complete decomposition of kyanite to mullite occurs at cone 15. A study of the use of Virginia kyanite in refractories is in progress.[6]

Production of kyanite grog is being investigated,[2] and several bonds have shown promising results.

North Georgia kyanite schist contains from 4 to 8% of kyanite, about 25% of commercial mica, small quantities of graphite as commercial products, and silica, iron minerals, and slimes as impurities. Kyanite is separated from the gangue by mulling, screening, and jigging; mica is recovered by settling, screening, and tabling; and graphite is recovered by flotation.

X-ray studies show that lightly calcined magnesite is cryptocrystalline with an atomic structure identical with that of periclase and fused magnesia.[8] In the materials tested, the difference between lightly calcined magnesite and periclase is simply one of particle size, and the transformation by heat-treatment effects neither a change from an amorphous to a crystalline form nor an inversion from one crystalline form to another but merely a recrystalliza-

tion, involving the growth of large crystals from smaller ones.

Other investigations on materials include (1) the colloidal behavior of certain nonplastics[1]; (2) X-ray and spectrographic methods for the analysis of ceramic materials (because of the complexity of chemical analysis of silicates, these two physical methods of examination, combined with optical means, are being studied as a way to determine the composition of minerals more directly[24]); (3) the beneficiation of talc[24]; (4) the acid solubilities of different talcs and the resulting effects in whiteware bodies[7]; (5) the fundamental properties of pyrophyllite[23]; (6) the production of an insulating refractory from pyrophyllite[2]; (7) an investigation on concentration of diaspore from low alumina clays[9]; (8) the effect of heat-treatment on the properties of garnet abrasive[13]; and (9) the thermal decomposition of topaz as a possible source of a high aluminous material for refractory purposes.[24]

References

(1) Pennsylvania State College, State College, Pa.
(2) University of North Carolina, Raleigh, N. C.
(3) The Ohio State University, Columbus, Ohio.
(4) Massachusetts Institute of Technology, Cambridge, Mass.
(5) University of Illinois, Urbana, Ill.
(6) Virginia Polytechnic Institute, Blacksburg, Va.
(7) University of Washington, Seattle, Wash.
(8) New York State College of Ceramics, Alfred, N. Y.
(9) Missouri School of Mines and Metallurgy, Rolla, Mo.
(10) Iowa State College, Ames, Iowa.
(11) Georgia School of Technology, Atlanta, Ga.
(12) University of Alabama, University, Ala.
(13) Rutgers University, New Brunswick, N. J.
(14) University of North Dakota, Grand Forks, N. D.
(15) West Virginia University, Morgantown, W. Va.
(16) University of Pittsburgh, Pittsburgh, Pa.
(17) University of North Carolina, Engineering Experiment Station, Raleigh, N. C.
(18) Ohio State University, Engineering Experiment Station, Columbus, Ohio.
(19) University of Illinois, Engineering Experiment Station, Urbana, Ill.
(20) Illinois Geological Survey, Urbana, Ill.
(21) Mellon Institute of Industrial Research, Pittsburgh, Pa.
(22) Battelle Memorial Institute, Columbus, Ohio.
(23) National Bureau of Standards, Washington, D. C.
(24) United States Bureau of Mines, Washington, D. C.; Southern Experiment Station and Electrotechnical Laboratory at Norris, Tenn.

—A. A. WELLS, *Chairman*

PATENT COMMITTEE SUGGESTIONS

Recent Changes in Patent Law

The 1939 report of this Committee (see *The Bulletin*, **18** [6] 211–12 (1939)) directed attention to certain proposals advanced by the Commissioner of Patents, Conway P. Coe. Since that time, proposals (4) to (7), together with proposal (3) in substance, have been enacted into law. The attention of The Society is directed particularly to two of these changes which became effective August 5, 1940.

(*a*) It is now necessary, in order to obtain a valid United States patent, to file the application within one year after public use or sale of the invention in this country or within one year after the invention has been described in any patent or printed publication. Previously the permissible period was two years.

(*b*) Where any claim of an issued United States patent is added to a pending patent application for purposes of interference, such claim must be copied into the application within one year from the date of the patent.

The Act of July 1, 1940, Public No. 700 (35 U.S.C.A. 42) was passed in the interests of national defense. It provides that when, in the opinion of the Commissioner of Patents, the publication or disclosure of an invention by the granting of a patent might be detrimental to public safety or defense, he may order the invention to be kept secret and withhold the grant of a patent for such period as may be necessary in the public interest. Violation of the order, as by disclosure of the invention or the filing of a foreign application without the approval of the Commissioner, may result in holding the invention to have been abandoned. Where such secrecy orders are obeyed and the inventions are tendered to the government, the owners may after receiving a patent bring suit for compensation in the Court of Claims, or certain government officials may enter into contracts providing for full settlement and compromise for the damage accruing by reason of the secrecy order and use of the invention by the government. The Act is to remain in force for a period of two years from its date. This Act is now being administered in the Patent Office with the cooperation of the Secretaries of War and the Navy and the Office of Production Management.

A patent covering an article is infringed by the sale of that article in this country, even though the article be made in a foreign country. When the patent is restricted to a process of making an article, however, articles made by the process in a foreign country may be freely introduced into and sold in this country. There has been agitation for some years to have enacted a law under which a process patent would be infringed by articles made by the process in a foreign country. Such bills have failed of passage by Congress, but the same effect is apparently produced by the Act of July 2, 1940, Public No. 710, which provides that the importation for use, sale, or exchange of a product made, produced, processed, or mined by means of a process covered by the claims of any unexpired United States Letters Patent shall have the same status for the purposes of the Tariff Act of 1930, Section 337, as the importation of any product or article covered by any unexpired United States patent. Under this Act, it is thus apparently possible to prevent entry into this country of products made in a foreign country by processes covered by unexpired United States patents, provided the importation of such products would have the effect or tendency of destroying or substantially injuring an industry operated in this country, or of preventing the establishment of an industry, or of restraining or monopolizing trade and commerce.

Legislation Pending Before Congress

All bills pending before the Seventy-Sixth Congress expired with its adjournment. A number of patent bills of importance have been introduced into the present Congress, and of these the most important deal with matters of national defense.

H.R. 3206 is the same as H.R. 8441 of the last Congress. This bill amends the present statute (R.S. 4898) under which assignments of patents may be recorded in the Patent Office, the purpose being to expand R.S. 4898 so that its provisions will apply to assignments of applications for patent. Such an amendment is meritorious because there is some question whether R.S. 4898 as construed in the courts applies to applications for patent. The bill would insure for assignees of applications full protection for the inventions which they have acquired. The Committee approves this bill in principle.

H.R. 3207: This bill is the same as H.R. 6721 of the

last Congress, which in turn replaced H.R. 3605. It provides for an increase in the classification staff of the Patent Office. H.R. 3605 was approved by The Society in 1939, and the reasons which impelled that approval apply equally to the present bill. It is recommended by the Committee that this bill be approved.

H.R. 3211: This bill takes the place of S. 2688 of the last Congress, which was reported favorably in the Senate but which died with the adjournment of the Seventy-Sixth Congress. It is a bill to put into effect the so-called twenty-year plan which was approved by The Society in 1939. The reasons applicable then are applicable today, and approval of the bill is recommended.

H.R. 3359: This is a bill intended to implement Public No. 700, which is deficient in that it may be evaded and the penalties are probably insufficient to prevent disclosure of inventions which may be critical to national defense. It could be evaded, for example, by filing an application for patent in a foreign country prior to filing in this country, and the mere holding of abandonment of an invention could be an insufficient deterrent to making disclosures of such an invention. Public No. 700, moreover, requires the issuance of a secrecy order by the Commissioner of Patents before its provisions apply. Under H.R. 3359, no person would be permitted to file an application for foreign patent without the authorization of the Commissioner of Patents, so that the foregoing way of evading Public No. 700 would be closed and the provisions would apply even though a secrecy order had not been issued. Also, under the pending bill, the publication or disclosure of an invention, or the filing of a foreign application, without authorization would be punishable by a fine of $10,000 or by imprisonment for not more than two years, or both. The Committee feels that every American and every American organization will wish to do anything necessary for the national interest and public defense at this time. Those directly concerned with matters such as covered by Public No. 700 and this bill apparently believe that it falls in that category. The Committee therefore approves this bill.

H.R. 3360: This is another bill in the interest of national defense. As introduced into Congress, it provides that where the manufacture, use, or sale of an invention covered by a United States patent is necessary to the national defense or required by the public interest or public safety, no injunction based upon any such patent shall issue or be enforced during the continuance of the national emergency declared by the President to exist on September 8, 1939, and that the sole recovery of the patent owner shall be the reasonable compensation for the infringing acts. In principle this bill is perhaps desirable for its stated purpose because some manufacturers may hesitate to enter into national defense production for fear of infringing patents. The prohibition against injunctions in the bill is not restricted, however, to operations involving national defense, and the Committee believes that it should be so restricted for obvious reasons. The Committee also feels that the reasonable compensation of the bill should be paid currently by the infringer to the patent owner because otherwise the latter might find himself unable to collect at the end of the emergency, owing to the fact that the infringer had distributed all of his profits and had no assets, or for other reasons. Subject to these proposed changes, the Committee approves this bill in principle.

Hearings have been held on H.R. 3360 and, during their course, Mr. Shea, Assistant Attorney General of the United States, proposed a substitute for that bill. The first section is much like H.R. 3360 except that the compensation would be the reasonable value of a *nonexclusive license* under the patent. This would amount to a bill providing for compulsory licensing of patents, the principle which has been repeatedly introduced before and rejected by Congress and one which is repugnant to our patent system.

Section 2 of Mr. Shea's substitute bill provides that when the President shall determine it to be in the interest of national defense he may acquire United States patents, applications therefor, inventions or licenses by donation, purchase, condemnation, or otherwise, and to issue licenses thereunder. Condemnation would be accomplished merely by filing a declaration of taking in the United States Patent Office with notice to the record owner of the patent. The owner would be relegated to suit against the government in the Court of Claims as his exclusive remedy. This section likewise would effectively become a compulsory licensing bill, and it would permit the taking by the government of any patent or group of patents in any industry or industries upon the mere certification that it would be in the interest of national defense. No patent owner and no industry could safely rely upon patents as the basis for beginning an industry or for increasing investment based upon patents if this bill were to be enacted into law. It would contravene constitutional guarantees and the fundamental premise upon which patents are granted in this country.

The Committee feels that everything necessary in the interests of national defense so far as concerns patents would be accomplished by Public No. 700, amended and implemented by H.R. 3359 and H.R. 3360 as introduced into the House of Representatives, that the proposed substitute for H.R. 3360 introduced by Mr. Shea is therefore unnecessary in the interests of national defense and would vitally disturb our patent system and industries based on it, and therefore recommends that H.R. 3360 be approved as introduced and that the substitute bill be disapproved.

Proposed Changes in Patent Law

The Society has heretofore approved in principle the creation of a single Court of Patent Appeals. This subject was discussed in the reports for 1938 and 1939 and therefore needs no elaboration at this time. The Committee recommends that The Society signify to Congress its approval in principle of this proposal with the introduction of a bill in line therewith.

Under the present practice in the Patent Office, it is necessary for an applicant for patent to sign his name at three places in the formal application papers. This not only is an annoyance but failure to sign at one of those places can create prejudicial delay. It has from time to time been proposed that the practice be changed so that but a single signature will be necessary. The Committee recommends that The Society signify to Congress its approval of this proposal together with the introduction of a bill directed to that end.

In the preponderance of cases, the assignor of an application has no further interest in it. In the prosecution of such an application, however, it may, and commonly does, become necessary to file a divisional application or a continuation application or to reissue a patent granted thereon. It happens from time to time that the assignor cannot be found or for one reason or another refuses to execute such divisional, continuation, or reissue applications. This situation would be alleviated by a bill permitting an assignee to file a true division, a continuation, or a reissue application. It is recommended that The Society signify to Congress its approval of the desirability of such a bill.

Consequent upon the hearings before the Temporary National Economic Committee, proposals have arisen for drastically limiting the rights of patent owners. One of these proposals would make it unlawful to grant any license containing any limitation to territory, field of use, quantity production, sale price, and the like. No legislation is known to be pending directed to that end, but the matter may become active after the final report of TNEC is filed, and it is of such importance that, if the work of this Committee is continued, the views of the membership of The Society would be helpful in consideration of the questions involved.

Committee Recommendation

The Committee recommends that the action taken by The Society upon its foregoing recommendations be reported to the proper Committees of Congress for their guidance.

Signed by the Committee on Patents: J. C. HOSTETTER, FRANK H. RIDDLE, AND FULTON B. FLICK, *Chairman*.

ENAMEL DIVISION STANDARDS COMMITTEE REPORT

The difficulty of producing standard tests has been recognized by past Standards Committees of the Enamel Division. Because the Committee on Standardization of Tests for Products of the Porcelain Enamel Institute serves the same function and because it is better organized to develop tests, recommendations have been made that the two Committees cooperate on this work.

It is the opinion of this Committee that cooperation can best be carried out in three ways, namely, (*a*) by locating members of The American Ceramic Society who are willing to acquire apparatus and work with the P.E.I. Committee on development of tests; (*b*) by acting as the Enamel Division clearing house for ideas on tests in use or on tests that are needed; and (*c*) by urging the adoption by The American Ceramic Society of P.E.I. standard tests.

The Enamel Division has only two recognized standard tests and one tentative standard test. These are (1) the Cone Fusion Test (standard); (2) the Standard Method of Fineness of Wet-Milled Enamels; and (3) the Determination of Resistance of Porcelain Enamel to Deflection (tentative) (see *Bull. Amer. Ceram. Soc.*, **13** [9] 269–71 (1930)).

This Committee recommends that The Society, through the Enamel Division, adopt as standard tests the "Reflectance Test for Opaque White Porcelain Enamels," and the "Test for Acid Resistance of Porcelain Enamels (Part I, Flatware)."

The reflectance test has been recommended for adoption as standard by two previous committees (see *Bull. Amer. Ceram. Soc.*, **16** [4] 173 (1937); **18** [6] 215 (1939)). This Committee feels that its adoption by The American Ceramic Society would merely be an official recognition of an accepted standard test.

The recent revisions in the acid-resisting test have seemingly overcome objections to it, as evidenced by its increased usage, and it has been adopted as standard by the P.E.I.

—CLARK HUTCHISON, *Chairman, Standards Committee*

REPORT OF THE INTERNATIONAL COMMISSION OF GLASS TECHNOLOGY

The abnormal conditions throughout the world have had their anticipated effect on international cooperation in research. Long-range projects apparently have had to be set aside for the immediate, specific job that has to be done in each country. This unfortunate interruption to the European program as well as the difficulty of communication with the countries represented on the International Commission has imposed a heavy responsibility on the glass technologists of America who, so far at least, are still free to carry on normal research work. During 1940, we have endeavored to keep alive certain specific projects assigned to us by the International Commission; we have also been active in other fields of glass technology.

On reviewing the work of the year, we in America feel that we have been reasonably successful in meeting this responsibility to the Commission to carry on during this period of stress.

A.S.T.M. Committees

The work of the International Commission has been set up under the auspices of A.S.T.M. in order to utilize their effective system of coordination established over a period of years rather than to set up a new mechanism that might tend to complicate rather than simplify the standardization picture. Committee C-14, A.S.T.M., and related subcommittees have carried on under the effective leadership of G. W. Morey. The Secretary, Louis Navias, will cover the details of the Committee activities in his report. The International Commission, however, is interested in all activity leading to ultimate standardization of tests in the glass industry, and there are other committees in the A.S.T.M. whose activities fall in this field. To illustrate, Committee D-13 on Textile Materials covers glass fiber and products made therefrom, and Committee D-9 on Electrical Insulating Materials quite naturally also deals with glass.

The International Commission is tied in to Committee C-14 by representation of your chairman on the Commission as a member of the Advisory Committee. It is recommended that consideration be given (1) to permit direct similar representation on other A.S.T.M. committees dealing with glass or (2) to set up a mechanism by which such committee activities on glass are brought to the attention of the writer.

In the report of March 19, 1940, it was mentioned that discussions had been started to lead to the setting up of a mechanism by which A.S.T.M. standards could be transmitted abroad. It was felt that it would be most satisfactory to work through established channels if such could be arranged. Your chairman is happy to report that with the hearty cooperation of Mr. Warwick, Secretary of A.S.T.M., and of Doctor Agnew, Secretary of the American Standards Association, A.S.T.M. tests and specifications may be released directly to the International Commission, provided, however, the American Standards Association, which normally is the connecting link with the International Standards Association, is kept advised of such action. When normal times are here once more, this tentative setup may be subject to change.

On this basis, copies of Tentative Specifications C-147, C-148, C-149, and C-158 from Committee C-14; D-578, D-579, D-580, and D-581 from Committee D-13 (Textile Materials); and D-468 and D-550 from Committee D-9 have been forwarded to W. E. S. Turner in England.

Communications from W. E. S. Turner

That the activities in America are of interest and value to our colleagues in England is indicated by the following quotation from Professor Turner's letter of August 27, 1940:

"I want to thank you in the first place for the copy of the minutes of the Atlantic City Meeting of the A.S.T.M. Committee C-14. As you can judge, our technical committee work here is severely restricted and proceeds under difficulties. It is actually being carried on and makes some progress. The claims on technical staffs, however, are manifold. First of all, some have been claimed for technical posts associated with the fighting services and some have joined H. M. forces and are on strictly military duties. I am bound to say that the majority remain, because the country has learned that technical services are essential to carry on the many and varied aspects of this war.

"The technical men who are left not only work under increasing difficulties because of restrictions of supplies, etc., but also they have had to assist in working out technical schemes for protecting our factories as well as our homes from the results of bombardments from the air; many of them are members of the A.R.P. and many of them now in addition belong to the Home Defense Guard, both of which organizations may result in their having to turn out at any and all hours of the night and day.

"In these circumstances, I think I may express not only my own view as President of the International Commission but also that of my colleagues associated with our work in England, when I say that, in America in your Committee, you are carrying on work of extreme value not only to yourselves but to glass technology in this and other countries. I should like in this letter to express my grateful thanks and to ask you to convey these thanks to the technical committee or committees who are carrying on such good work. I do not know how the A.S.T.M. would be disposed to view the suggestion that we on this side might even, in the circumstances, be prepared to adopt the specifications recently issued for the tentative methods to be followed in the Hydrostatic Pressure Test, the Polariscopic Examination of Glass Containers, and the Thermal Shock Test on Glass Containers. The committees of the Society of Glass Technology have been working actively on all these three subjects for some time past, and interim

reports have been received. I propose to submit to them the copies of the printed documents describing the tentative methods and to invite an expression of opinion."

The October, 1940, *Journal of the Society of Glass Technology* carries Specifications C149–40T, C148–40T, and C147–40T. In presenting these to his readers, Professor Turner wrote as follows:

"When, in 1936, the International Commission on Glass invited The American Ceramic Society to undertake the review of certain problems in glass technology and to prepare draft specifications for consideration and possible adoption at the next following International Congress on Glass, a good deal of thought was given to the most suitable manner of organizing the work. The American Society for Testing Materials (A.S.T.M.) had already achieved an authoritative national position in the field of standardization, and it was ultimately decided by The American Ceramic Society to become associated with that body, instead of setting up its own committees to carry forward the tasks remitted to it by the International Commission.

"I should like, as President of the International Commission, to acknowledge the wisdom of that decision. The work of a number of these A.S.T.M. committees is now bearing fruit and, with the kind approval of the American Society for Testing Materials, which we gratefully acknowledge, we are able to reproduce in these pages three recent specifications, and others will appear in a subsequent issue.

"The three specifications reprinted here are concerned with subjects which are also engaging the attention of technical committees of our own Society and might before now have been brought to a head but for the grimmer responsibilities which have arisen during the past fifteen months. In these circumstances, the labours of our American colleagues are of special value to us. Mr. Warwick, when writing to give on behalf of the A.S.T.M. approval for the reproduction of the specifications, also kindly placed at our disposal photographs of the illustrations embodied in two of them."

In conclusion, we believe that with minor changes the present arrangement with A.S.T.M. is working out satisfactorily and that the Glass Division, through A.S.T.M. committees, is doing a constructive job that should be continued with vigor.

Respectfully submitted, J. C. HOSTETTER, *Chairman*

A. V. BLEININGER, HONORARY MEMBER

Albert Victor Bleininger was born in Polling, Germany, on July 9, 1872, and he attended the grade and high schools in Munich. He was graduated from Ohio State University in 1901 with the degree of Bachelor of Science in Chemistry; in 1933, he received the degree of Doctor of Science from Alfred University. In 1932, he was honored with the Lammé Medal award from Ohio State University.

Dr. Bleininger joined The American Ceramic Society in 1899, being one of the Charter Members. When the Industrial Divisions were organized, he joined the White Wares Division and since that time he has worked with that group. He was elevated to Fellow Member in 1936, and on March 31, 1941, he was elected an Honorary Member of The Society. He was Trustee of The Society in 1903; Vice-President in 1904; President in 1908; and again elected Trustee in 1923 for three years; he has also acted as chairman of several committees.

Dr. Bleininger is a member of the American Chemical Society; Chairman of the Research Committee of the U. S. Potters Association; and a Fellow of the American Association for the Advancement of Science.

From 1901 to 1907, Dr. Bleininger was assistant professor of ceramics at Ohio State University, and he held the same position at the University of Illinois during 1907 and 1908. From 1908 to 1910, he was head of the Clay Products Section of the U. S. Geological Survey; and from 1910 to 1912, he was head of the Department of Ceramic Engineering at the University of Illinois.

In 1912, he became chief of the Division of Ceramics at the U. S. Bureau of Standards, which position he held until 1920. Since 1920, he has been chief chemist at the Homer Laughlin China Company of Newell, W. Va.

Professional and Practical Achievements

(1) Survey of the Portland cement industry, Ohio Geological Survey, 1900–1904.

(2) Responsible for two buildings and equipment, Ceramic Department, University of Illinois, Urbana, Ill.

(3) Equipped the ceramic laboratory for the U. S. Geological Survey in Pittsburgh, Pa.

(4) Started research in glass, enameled metal, and porcelain at the Bureau of Standards; began the making of optical glass in 1916; helped build optical glass plants in Pittsburgh and Washington.

(5) Worked on spark plugs; a clay catalyzer for ethylene production; the replacement of imported by domestic materials; an investigation of causes of crazing; and the production of new bodies and glazes for the semi-vitreous industry.

Among the research publications of Dr. Bleininger are the following:

"Manufacture of Hydraulic Cements," *Ohio Geol. Survey* (1904).

"Physical Chemistry of Fusing Silicates," *Trans. Amer. Ceram. Soc.* (1907).

"Behavior of Fire Brick Under Load" (with G. H. Brown), *ibid.* (1910).

"Vitrification Range and Dielectric Behavior of Porcelains" (with R. T. Stull), *ibid.* (1910).

"Effect of Preliminary Heat Treatment," *ibid.* (1910).

"Viscosity of Slip Clays" (with H. H. Clark), *ibid.* (1910).

"Compressive Strength and Transverse Strength of Dry Clays" (with W. L. Howat), *ibid.* (1914).

"Flow of Clay Under Pressure" (with D. W. Ross), *ibid.* (1914).

"Properties of American Bond Clays" (with G. A. Loomis), *ibid.* (1917).

"Special Pots for Melting of Optical Glass," *Jour. Amer. Ceram. Soc.* (1918).

"Use of American Materials in Manufacture of Whiteware Pottery" (with W. W. McDanel), *ibid.* (1920).

U. S. Patent 1,528,908.

APPRECIATION OF HONORARY MEMBERSHIP

Newell, West Virginia
April 11, 1941

Dear Dr. Purdy:

Permit me to express to the Board of Trustees and to the Fellows my deep appreciation and thanks for the high honor which has been bestowed upon me. Words fail me in this connection. I feel so keenly my unworthiness of the Honorary Membership and I never dreamed that I should be its recipient.

Again expressing my thanks and gratitude, I am,

A. V. BLEININGER

FELLOWS INDUCTED MARCH 31, 1941

ALICE ANN AYARS, teacher in charge of Ceramic Center, 12479 Cedar Road, Cleveland Heights, Ohio

ALFRED EARL BADGER, Research Assistant Professor of Ceramic Engineering, University of Illinois, Urbana, Ill.

GEORGE JOHN BARKER, Assistant Professor, University of Wisconsin, Madison, Wis.

DWIGHT GRANVILLE BENNETT, Industrial Fellow, Mellon Institute, Pittsburgh, Pa.

HAROLD THORNTON COSS, Director, Mineral Wool Section, J-M Research Laboratories, Manville, N. J.

HASCALL BURTON DUBOIS, Sales Engineer, Consolidated Feldspar Corporation, Trenton, N. J.

JACOB EUGENE EAGLE, Service Manager-Ceramic Research Director, Vitro Manufacturing Company, Pittsburgh, Pa.

ROGER LEE FELLOWS, Assistant Director of Research, Chicago Vitreous Enamel Product Company, Cicero, Ill.

EDWIN LEVI HETTINGER, Optical Research Engineer, Willson Products, Incorporated, Reading, Pa.

OSCAR HOMMEL, President, The O. Hommel Company, Pittsburgh, Pa.

KARL KAUTZ, Ceramic Engineer, Climax Molybdenum Company, Langeloth, Pa.

WALTER RONALD LESTER, Chief Chemist, Maryland Glass Corporation, Baltimore, Md.

GUSTAV ERNST FREDRICK LUNDELL, Chief, Chemistry Division, National Bureau of Standards, Washington, D. C.

AARON KERR LYLE, Glass Technologist, Hartford-Empire Company, Hartford, Conn.

JOHN WHITE MCBURNEY, Senior Technologist (Ceramics), National Bureau of Standards, Washington, D. C.

GLENN HAZEL MCINTYRE, Director of Research, Ferro Enamel Corporation, Cleveland, Ohio.

GEORGE WASHINGTON MOREY, Physical Chemist, Geophysical Laboratory, Washington, D. C.

WILLIAM RAY MORGAN, Research, Bay State Abrasive Products Company, Westboro, Mass.

WILBUR HENRY PFEIFFER, Section Head, Materials & Process Engineering Division of General Motors, Dayton, Ohio

OLIVER CALDWELL RALSTON, Chief Engineer, Nonmetals Division, U. S. Bureau of Mines, College Park, Md.

GEORGE BICKLEY REMMEY, Director of Research, Richard C. Remmey Son Company, Philadelphia, Pa.

RALSTON RUSSELL, JR., Research Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

HENRY ZANE SCHOFIELD, Research Director, National Paving Brick Association, and Research Fellow, Engineering Experiment Station, Ohio State University, Columbus, Ohio

GILBERT EDWARD SEIL, Technical Director, E. J. Lavino and Company, Norristown, Pa.

GEORGE REED SHELTON, Ceramic Chemist, National Bureau of Standards, Washington, D. C.

GILBERT YSIDRO SOLÈR, Manager of Research and Mill Metallurgical Departments, Steel and Tube Division, Timken Roller Bearing Company, Canton, Ohio

LUDWIG ERNEST THIESS, Ceramic Engineer, General Electric Company, Schenectady, N. Y.

ARTHUR ATKINSON WELLS, Vice-President and General Superintendent, Homer Laughlin China Company, East Liverpool, Ohio

CERAMIC CAMERA CLUB EXHIBIT

Frazier Award to E. L. Hettinger

The Chauncey E. Frazier Award of Merit of The American Ceramic Society was presented to E. L. Hettinger of the Willson Products, Inc., Reading, Pa., at the annual dinner meeting of the Ceramic Camera Club in the Lord Baltimore Hotel, Baltimore, Md., Wednesday evening, April 2.

President E. L. Hettinger, as a token of respect to the late J. M. McKinley, founder of the Ceramic Camera Club, asked that a silent invocation be given.

J. L. Carruthers, president of The American Ceramic Society during 1940–1941, spoke briefly and presented the Chauncey E. Frazier Award. Professor Carruthers told of his early association at Ohio State University with the son of the designer and creator of the Frazier plaque, namely, Frederick Carder of the Steuben Division of the Corning Glass Works. He also expressed his great fondness for the Carder family. In presenting this exquisite piece of artistic glass, he spoke of his pleasure in the opportunity of giving it to Mr. Hettinger for his excellent picture, "Hand-Blowing Window Glass." He also thanked the judges, Francis C. Flint, Washington, Pa.; Charles D. Spencer, Cleveland, Ohio; and J. Palin Thorley, Pittsburgh, Pa., for their time and effort in selecting the recipient for this Award. Professor Thorley was unable to attend the meeting because of illness and a telegram was received from him expressing his regrets.

Mr. Hettinger, in accepting the Award, expressed his delight in being so honored, and he outlined his association and acquaintance with Frederick Carder, Mrs. Carder, and the Frazier family.

Mr. Hettinger presented John S. Rowan, chairman of the judges for the Third Annual Salon, who introduced the two other Baltimore judges, Mr. Barkley and Mr. Emery, and also Charles Clayton, professional photographer from Baltimore.

Mr. Rowan gave high praise to the quality of pictures shown at the Salon; he also expressed his appreciation and that of the other judges in being able to help with the selection of the various classification winners. He introduced the lady guests from Baltimore, together with the two young ladies, Miss Helen Hayes and Miss Louise Boteler, who served as models for the members to photograph. Dr. Purdy and Miss Eckardt also served as models.

President Hettinger then presented to J. Earl Frazier, Secretary-Treasurer of the Ceramic Camera Club, a large ash tray of ground and polished glass for submitting the most outstanding print quality portrait, "El Chico."

WINNERS OF AWARDS

Classification	Award	Picture title	Exhibitor
Pictorial	First Prize	Main Sheet	Davidge H. Rowland
	Honorable Mention	Donner Peak	George A. Mays
Action	First Prize	Three-Point Landing	G. Milton Ehlers
	Honorable Mention	Receiver Had No Chance	J. Earl Frazier
Portrait	First Prize	Duet	Davidge H. Rowland
	Honorable Mention	Hungarian Girl	Roy W. Wampler
Industrial	First Prize	Glass Skimmer	Rexford Newcomb, Jr.
	Honorable Mention	Hand-Blowing Window Glass	E. L. Hettinger
Scientific	First Prize	Graveyard	L. M. Austin

(There was no second award or honorable mention given in the scientific class.)

Board of Governors

A business meeting followed the program. The Board of Governors of the Ceramic Camera Club elected were *Chairman*, G. Milton Ehlers, Globe-Union Co., Milwaukee, Wis.; *Secretary-Treasurer*, Robert W. Knauft, Charles Taylor Sons Co., Cincinnati, Ohio; and V. H. Remington, B. F. Drakenfeld Co., Washington, Pa.; W. R. Schlehr, Carr-Lowrey Glass Co., Baltimore, Md.; and C. D. Spencer, General Electric Co., Cleveland, Ohio.

ANNUAL MEETING INCOME AND EXPENSES FOR 1941

INCOME		
Registration	$4435.00	
General luncheon	215.00	
Glass Division luncheon	139.60	
Structural Clay Products luncheon	28.00	
White Wares Division luncheon	64.00	
Enamel Division luncheon	69.00	
Refractories Division luncheon	45.00	
Refund from Local Committee	17.30	$5012.90
EXPENSES		
General luncheon	$ 236.50	
Glass Division luncheon	143.00	
Structural Clay Products Division luncheon	33.00	
White Wares Division luncheon	70.40	

Enamel Division luncheon	75.90	
Refractories Division luncheon	45.00	
Microphones and transformers	62.39	
Signs and plywood for shipping	53.08	
Board and Local Committee dinner	54.50	
Board breakfast and luncheon	38.00	
Editorial breakfasts	17.75	
Student Reception and general luncheon entertainment	147.85	
Ceramic books	93.00	
Packing equipment, porter, and bell boys	14.00	
Office staff expenses	294.08	
General Secretary expenses	150.00	
Boys for Meeting service	216.75	
Pinkerton Detective Agency	207.50	
Badges and lettering	117.79	
Postage	58.48	
Printing registration cards	25.34	
Preprints for publicity	14.12	
Telegrams	39.80	
Long-distance telephone calls	17.13	
Printing programs	645.26	
Express charges	19.79	
Binding	1.00	
Rental of movie projector	8.00	
Reporting	321.00	
Syracuse Exhibit	100.00	
Local Committee	1000.00	
Preprinting papers	167.72	$4488.13
		$ 524.77

REGISTRATION ATTENDANCE

816 men at $5.00
142 ladies at $1.00
142 students at $1.50

1100
47 service

1147

Local Committee Income and Expenses

INCOME		
Allowance from The Society	$1000.00	
Income sale of plant trip tickets	130.00	
Night on Chesapeake	1218.00	$2348.00
EXPENSES		
National Theatrical Agency	$ 680.00	
Lord Baltimore Hotel (night on Chesapeake)	1116.60	
Ladies' prizes	34.85	
Ladies' Committee (Mrs. L. C. Roche, *Chairman*)	44.25	
Bus tickets	21.00	
Buses	195.00	
B. & O. Glee Club	50.00	
W. A. Weldon, *Chairman* (miscellaneous expenses)	50.00	
Committee miscellaneous expenses (luncheons, transportation, gratuities, etc.)	100.00	
Ladies' Tea (Sunday, March 30)	39.00	$2330.70
Balance (refunded to The Society)		$ 17.30

Membership in
The American Ceramic Society

FOR CONTINUING EDUCATION IN CERAMICS

NEW MEMBERS FOR APRIL

Corporation

AMERICAN PORCELAIN ENAMEL CO., Robert Long (voter), Muskegon, Mich.

Personal

AMMERMAN, J. H., 16 S. Jones St., Lock Haven, Pa.; head of Research Lab., North American Refractories Co.

BYRD, JOHNIE J., R.F.D. 7, Tyler, Tex.; owner, Tyler Pottery.

CAINE, FREDERICK W., Brittains Bricks & Pipes Pty. Ltd., Darra, near Brisbane, Queensland, Australia; director.

DANA, L. I., Linde Air Products Co., East Park Drive & Woodward Ave., Tonawanda, N. Y.

GARDNER, WALTER E., 4003 Lewiston Rd., Niagara Falls, N. Y.; ceramic chemist, Titanium Alloy Mfg. Co.

HAUSER, ERNST A., Massachusetts Inst. of Technology, Cambridge, Mass.; associate professor of chemical engineering.

HERSCHEL, WINSLOW H., 6305 Florida St., Chevy Chase, Md.; National Bureau of Standards.

HIGGINS, WALDO W., 5415 N. Shoreland Ave., Milwaukee, Wis.; director of ceramic research, A. O. Smith Corp.

HUMMEL, FLOYD A., 447 Whittier Ave., Syracuse, N. Y.; ceramic chemist, Onondaga Pottery Co.

KREHBIEL, HELMER O., 235 W. Mill St., Pataskala, Ohio; superintendent, Accurate Pyrometric Cone Co.

MOWREY, FRED W., 405 Jones St., Belle Vernon, Pa.; chemist, American Window Glass Co.

NORDBERG, MARTIN E., 244 Chenning St., Corning, N. Y.; research chemist, Corning Glass Works.

ROWLAND, DAVIDGE H., 3906 Cloverhill Road, Baltimore, Md.; chief ceramic engineer, Locke Insulator Corp.

SANDERS, CLYDE A., Lawrence Clay Co., Jackson, Ohio; ceramic engineer.

*SMITH, KENNETH M., Severn Clay Co., 2618 St. Paul St., Baltimore, Md.; sales manager.

SMITH, RUSSELL J., Michigan College of Mining & Technology, Houghton, Mich.; instructor, Metallurgical Engineering Dept.

SPARKS, EDGAR W., 406 Unaka Way, Erwin, Tenn.; ceramic engineer, Southern Potteries, Inc.

* Former member of The Society rejoining.

Student

Georgia School of Technology: ALEX PUPULIDY.
Iowa State College: K. WARREN ROLLINS.
Massachusetts Institute of Technology: ANDREW L. JOHNSON.
Missouri School of Mines and Metallurgy: WILLIAM E. CROCKETT and JOSEPH T. DUSZA.
North Carolina State College: WINGATE A. LAMBERTSON.
Ohio State University: HOWARD E. PETTY.
Virginia Polytechnic Institute: JOHN E. FUNNELL, BEVERLY L. GIVENS, and GRIFFITH G. SMITH.

MEMBERSHIP WORKERS' RECORD

Corporation

W. F. Wenning 1

Personal

Thomas Campbell	1	W. W. Kriegel	1
J. L. Carruthers	1	R. T. Stull	1
C. H. Commons, Jr.	1	S. M. Swain	1
L. P. Forman	1	W. A. Weldon	1
J. F. Krehbiel	1	Office	8

Student

J. L. Carruthers	1	J. W. Whittemore	3
C. M. Dodd	1	C. F. Wysong	1
P. G. Herold	1	Office	2
W. W. Kriegel	1		

Grand Total **28**

CERAMIC CORPORATIONS MUST BE SOLD ON THE VALUE RECEIVED FROM THIS SOCIETY

146 Domestic and 71 Across-Seas Personal Members Are Delinquent

Several "Delinquents" Will Pay Their Dues

The Draft Has Taken Many Personal Members

The loss in 1941 of fifteen (15) Corporation Members by their failure to pay dues is serious, notwithstanding the net gain of six (6) over the 1940 record of same month.

CERAMIC CORPORATIONS SHOULD BE SOLICITED

Paid Membership Record

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1940	1995	260	25	574	220	3074
January 20, 1941	2007	262	27	594	220	3110
March 10, 1941	2023	257	26	620	220	3146
April 21, 1941	1794	247	47	563	220	2871
April 17, 1940	1724	241	30	522	220	2737
Gain or Loss	+70	+6	+17	−41		+134

ROSTER CHANGES DURING APRIL*

Personal

BAER, F. L., Park Lane, 299 Park Avenue, New York, N. Y. (Montreal, Quebec, Canada)
BERNS, MILTON H., 22 Hillview Place, Hamburg, N. Y. (Blasdell, N. Y.)
CHARLES, ROBERT G., 8808 Carnegie Ave., Cleveland, Ohio (Minerva, Ohio)
FICHTER, GEORGE W., 1110 Dartmouth St., Chattanooga, Tenn. (Rossville, Ga.)
FOOTE, E. H., JR., Box 1092, Charleston, W. Va. (Medina, Ohio)
HARCOURT, EDWARD L., 44 E. Norwich Ave., Columbus, Ohio (Johnstown, Pa.)
HOSSENLOPP, ARTHUR M., 11 Colonial Court, Metuchen, N. J. (Keasbey, N. J.)
JACKSON, ARTHUR W., Harbison-Walker Refractories Co., Box 311, Fairfield, Ala. (Malvern, Ark.)
LOUDEN, R. H., McGean Chemical Co., 1106 Republic Bldg., Cleveland, Ohio (Anderson, Ind.)
MATTHEWS, SAMUEL, Dominion Fire Brick & Clay Products, Ltd., Claybank, Saskatchewan, Canada (Saskatoon, Sask., Canada)
MONTGOMERY, E. T., 3917 W. Hanover Street, University Park, Dallas, Tex. (Georgetown, Ontario, Canada)
MULLER, MAX M., 111 Highland Ave., Apt. 301, Highland Park, Mich. (Flint, Mich.)
PHILLIPS, EDWIN L., Box 513, East Liverpool, Ohio (Newport, Ky.)
REARDON, LESLIE J., 35–45 81st Street, Jackson Heights, L. I., N. Y. (New York, N. Y.)
ROSS, MYRON A., Pressed Prism Plate Glass Co., Morgantown, W. Va. (Chicago, Ill.)
RUPRECHT, BERTRAM C., Box 443, Homestead, Pa. (Pittsburgh, Pa.)
SAUNDERS, HOLLIS S., 184 Eddy Road, Cleveland, Ohio (East Rochester, N. Y.)
SPENCE, HAROLD I., 417 20th St., Manhattan Beach, Calif. (Los Angeles, Calif.)
SPIRES, STEPHEN T., North American Refractories Co., Mt. Union, Pa. (Womelsdorf, Pa.)
STAFFORD, W. L., Johns-Manville Products Corp., Zelienople, Pa. (Columbus, Ohio)
ZURER, RAYMOND R., 30 Daniel Low Terrace, New Brighton, Staten Island, N. Y. (Brooklyn, N. Y.)

* Address in parentheses is former address.

F. P. Hall, White Wares Division Trustee

R. L. Fellows, Chairman, Enamel Division

LOCAL SECTIONS

PITTSBURGH SECTION

Joint Meeting with Art Division

The Pittsburgh Section held its annual joint meeting with the Art Division on February 11. Exhibitions of ceramic art and American sculpture in the Cathedral of Learning and Heinz Chapel of the University of Pittsburgh and at Carnegie Museum furnished an afternoon program of much interest.

R. C. Purdy, General Secretary of The American Ceramic Society, acted as Master of Ceremonies "De Luxe" and Toastmaster "Extraordinary" at the dinner held in Webster Hall. J. L. Carruthers, President of The Society, voiced greetings from the parent Society in a short talk.

Following the dinner, the group met in the Auditorium of Mellon Institute for the evening program, which was in charge of J. Palin Thorley, Head of the Ceramic Art Department of the University of Pittsburgh.

Reverend J. L. Kelso, archeologist of the American School of Oriental Research, discussed ceramic archeology in the light of his experiences at the excavation of Tell Beit Mirsin. Lantern slides of vases, lamps, and other articles dug from ruins of 2000 B.C. showed that excellent skill, streamline designs, and certain processing stunts of today were not unknown then.

Frazier Smith, designer for the Hazel-Atlas Glass Corporation, analyzed creative design in glass from the standpoint of coordinating customer taste with mass production and other shop limitations.

Marion G. Yutzey, designer for the Fostoria Glass Company, showed "glamorous" table settings by means of exquisitely colored slides and appropriate comments.

The nationally known artist, H. Edward Winters, of Cleveland, Ohio, told of his lone-handed pioneering in creative designs in enamels. Full-color pictures of enameled articles, from matchboxes and ash trays to gorgeous plaques and massive murals, were shown. Mr. Winters is producing work in fired enamels on copper and steel that looks like and compares well with the tinting and coloring heretofore found only in oil paintings. His personal skill is unique and his matter-of-fact discourse of how he mastered some of his problems was fully as interesting as the display of some of his pieces.

About one hundred persons attended the dinner and more than one hundred and fifty enjoyed the evening program. The meeting this year was on a par with sessions of other years, and the Section is proud of its ability to put on these delightful art programs in the heart of the nation's biggest industrial center, Pittsburgh, the workshop of the world. —LOUIS A. SMITH, *Secretary*

CENTRAL OHIO SECTION

The Central Ohio Section held the first meeting of 1941 on March 7 at the Southern Hotel in Columbus. The meeting was in the form of a testimonial dinner for J. L. Carruthers, President of The American Ceramic Society for 1940–1941, and respects were paid to him by A. S. Watts and R. C. Purdy. E. B. Snyder represented the students in the Ceramic Department at Ohio State University.

The speaker of the evening was J. E. Wiss, U. S. Gypsum Co., Chicago, Ill., who gave an interesting discussion on gypsum and its uses in ceramics and the allied industries.

Officers for 1941–1942

Chairman: C. J. KOENIG, Engineering Expt. Station, Ohio State Univ., Columbus, Ohio.

Secretary-Treasurer: M. C. SHAW, Edward Orton, Jr., Ceramic Foundation, Columbus, Ohio.

Councillor: J. L. CARRUTHERS, Dept. of Ceramic Engineering, Ohio State Univ., Columbus, Ohio.

—M. C. SHAW, *Secretary*

SCHOOL NOTES

UNIVERSITY OF WASHINGTON

Plant Tour

On March 22 1941, seven students and one graduate student, with C. H. Zwermann and W. P. Keith, left for Los Angeles, Calif., on the annual ceramic engineering field trip. A stop-over was made at Crater Lake National Park in Oregon.

A full week was spent in the Los Angeles area and each day was devoted to at least two and sometimes more different types of manufacturing establishments. The plants included in the tour were Crystallite Products Co.; Gladding, McBean & Co. (Glendale plant); Pacific Clay Products Co.; Eljer-California Co.; Tillotson Clay Products Co.; Emsco Refractories Co.; Wallace China Co., Ltd.; Glass Containers, Inc.; Vitrefrax Corp.; and the U. S. Porcelain Enameling Co. The group also visited Glen Lukens at the University of Southern California.

In all of the plants visited, business seemed to be very good, which is a heartening note for the ceramic engineering profession. Many new ideas were gathered, and the trip proved to be highly beneficial for everyone.

On the return trip, the party toured the Johns-Manville plant at Lompoc, where the actual cutting of natural diatomite brick from the face of the deposit was shown. These diatomite formations, which are extensive, were interesting to observe.

The students wish to take this opportunity to thank each plant visited for the hospitality shown to them. A trip of this nature is extremely helpful to the engineering student. —JIM MCKINNELL, *Student Secretary*

VIRGINIA POLYTECHNIC INSTITUTE

The Student Branch of The American Ceramic Society at the Virginia Polytechnic Institute held a meeting on March 20, 1941. It was decided to obtain a sound movie entitled "Mazda Lamps Preferred" for the first meeting of the Student Branch in April. This film shows the development and manufacture of household-sized General Electric Mazda lamps.

The eleven seniors of the 1941 graduating class attended the Annual Meeting of The Society in Baltimore, where they also visited several ceramic plants.

Officers of the Student Branch for 1941–1942 are B. L. Givens, *President;* J. D. Thompson, *Vice-President;* S. L. Johnson, Jr., *Secretary-Treasurer;* and R. C. Womeldorph, *Corresponding Secretary.*

—R. C. WOMELDORPH, *Corresponding Secretary*

OHIO STATE UNIVERSITY

The first meeting of the spring quarter of the Student Branch of The American Ceramic Society was held on April 16, 1941.

D. E. Postlewaite, president, announced the plans for the new quarter which will include (1) a discussion meeting, (2) a "board of experts" composed of professors and men from the industry who will answer questions from the students relating to their attitude to the student and to that of the student when he applies for a job, (3) a picnic, and (4) a junior-senior banquet.

John Neff, an O.S.U. ceramic engineering graduate, who is employed by the Edward Orton, Jr., Ceramic Foundation, spoke on the "American Optical Glass Industry." A. S. Watts presented Ceramic Data Books to the three juniors and one sophomore who had the highest grades. The juniors were Albert Caton, John O. Semmelman, and Ralph Rose; the sophomore highest on the basis of scholarship was Eriol J. Weiss.

—R. H. THOMAS, *Secretary*

NECROLOGY

HERFORD HOPE

Word has been received of the death of Herford Hope of Devon, England, a Fellow of The American Ceramic Society, who passed away suddenly on the evening of February 1, 1941.

Mr. Hope was born on December 17, 1883, in London, England. He became associated in 1898 with the Mayer Pottery Company, Ltd., as foreman from 1904 to 1906. From September, 1906, when he came to the United States, to March, 1907, he was superintendent of the Huntington China Co., Huntington, W. Va. During 1906 and 1907, he also attended the University of Illinois, Urbana, Ill., for six months. From 1908 until 1920, he was superintendent of the Mayer China Company at Beaver Falls, Pa. Upon his return to England in 1921, he became associated with the Colne Brick & Terra Cotta Co., Ltd., at Colchester.

At the time of his death, Mr. Hope was owner-manager of the Devonmoor Art Pottery Co., Liverton, Newton Abbot, Devon, England, which was founded in 1922.

Society Affiliations

Mr. Hope became a member of The American Ceramic Society in 1906 and was affiliated with the Art and White Wares Divisions. He served as Treasurer of The Society from 1913 to 1917.

Publications in Transactions of The Society

"Biscuit Loss in Manufacture of White Ware," **8,** 62–78 (1906).

"Comparative Effects of the Oxides of Calcium, Magnesium, Strontium, Barium, and Zinc on Some China Bodies," **11,** 494–527 (1909).

"Pottery Molds," **12,** 494–503 (1910).

"An Experiment in Ceramic Education," **15,** 62–70 (1913).
"Shop Notes," **15,** 388–400 (1913).
"Pottery Casting Apparatus and Other Improvements," **16,** 235–43 (1914).
(With B. D. Hardesty) "Potters' Rotary Stoverooms," **16,** 418–30 (1914).

JOHN S. HERZOG

Word has reached the Secretary's office that John S. Herzog passed away on April 1, 1940, in California after an illness of a few weeks. Mr. Herzog had been a member of The Society since 1922 and was affiliated with the Materials and Equipment Division.

John S. Herzog

John S. Herzog was born in Minneapolis, Minnesota. He spent his childhood in St. Paul and attended the University of Minnesota where he took an engineering course. In 1909, he moved to Newark, Ohio, where he was associated with the Holophane Glass Company. He later organized a company and bought the Simpson Foundry Company in Newark to which he added an engineering department and changed the name to the Simpson Foundry and Engineering Company. Mr. Herzog was vice-president and manager of the business until his death.

NOTES FOR CERAMISTS

ILLINOIS GLASS CONFERENCE POSTPONED

The schedule of departmental activities during the remaining weeks of the school year at the University of Illinois makes impracticable an attempt to hold the Glass Conference in May as planned. This Conference will be deferred until autumn.

—C. W. PARMELEE

OHIO CERAMIC INDUSTRIES ASSOCIATION

The third annual outing of the Ohio Ceramic Industries Association will be held at the Zanesville Golf Club, Zanesville, Ohio, on May 23, 1941. In addition to Association members, any person connected with the ceramic industry is invited to attend this outing. Tickets, which will be $3.00 each, may be obtained by writing to H. E. Nold, Secretary, in care of the Ohio Ceramic Industries Association, Lord Hall, Ohio State University, Columbus, Ohio. Orders for tickets must be accompanied by check.

The officers of the Association are *President,* C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio; *Vice-President,* Harry Callahan, U. S. Quarry Tile Co., East Sparta, Ohio; *Treasurer,* E. E. Hillyer, Clay City Pipe Co., Uhrichsville, Ohio; and *Secretary,* H. E. Nold, Lord Hall, Ohio State University, Columbus, Ohio. Members of the Board of Trustees are J. Leo Child, Hancock Brick & Tile Co.; F. H. Johnson, Summitville Face Brick Co.; C. Forrest Tefft, Claycraft Co.; R. K. Beck, Metropolitan Paving Brick Co.; G. R. Robinson, Hocking Valley Brick Co.; W. Keith McAfee, Universal Sanitary Mfg. Co.; W. H. Locke Anderson, Edwin M. Knowles China Co.; B. T. Bonnot, the Bonnot Co.; and F. R. Henry, Simonds Worden White Co.

LETTER FROM W. E. S. TURNER

Excerpts from a letter written by W. E. S. Turner of Sheffield, England, to F. C. Flint, dated February 4, 1941; blank spaces denote parts censored.

"You no doubt have wondered how we have been faring, for you probably saw that Sheffield had a prolonged and concentrated raid on..... The city did indeed receive a tremendous battering with the destruction of a tremendous amount of property and a very big roll of dead and injured.

"I am happy to say that all members of the staff here came through uninjured, but the homes of several received injury. Mr. Duncan's lodgings received a direct hit, and several other members of the staff here were temporarily evacuated because of the presence.....lying near.

"Our new buildings suffered very greatly from the effects of blast from bombs dropped quite close to us. A number of.....dropped round the buildings and were extinguished without harm by those on night duty. The bombs dropped nearby shattered a very large proportion of our glass, both internal and external, destroyed one of our decorated windows, partly damaged two of the stained glass windows to which we were greatly attached by sentiment, and did damage of a less serious kind to other decorative pieces. You can imagine that in December, when practically all the windows of a big building are blown out and heating and lighting services rendered for a time useless, it is rather cheerless, risky, and difficult work carrying on. On the morning following the raid.....said to be.....unexploded within.....of the buildings and, although one or two people turned in later in the day and with myself began the job of clearing up the mess, I found it essential officially to evacuate everybody. It has taken quite a time to take up all the threads of work again. We were.....for.....and furnace operations were.....and laboratory operations....., particularly chemical operations, were greatly hampered, although we rigged up all kinds of.....devices to makeshift.

"You will be interested to know that all male members of the staff, and a number of the students, take it in turns in batches to sleep on the premises to strengthen our patrol and fire-fighting squad to meet emergencies. As most of us also have similar duties in our own roads and streets watching over residential property—our own homes—you can see that the claims of us as citizens take up an ever-increasing amount of time, and it may help you and our other American friends to understand the reason for delays in matters which would be carried through expeditiously in normal times."

PORCELAIN ENAMEL INSTITUTE TENTH ANNUAL MEETING

The tenth annual meeting of the Porcelain Enamel Institute was held at French Lick, Ind., on April 17 and 18. Forty-seven plant executives were present.

A. I. Andrews of the University of Illinois explained a new development in the operation of porcelain enameling furnaces. This improvement has eliminated many of the difficulties encountered in the use of conventional methods of firing porcelain enamels. It may also be adapted to other materials.

W. H. Pfeiffer, Engineering Dept., Frigidaire Div., General Motors Corp., showed the effect of this new development on the quality of porcelain enamel being produced. He stated that this method of firing may eventually be used by the appliance industry.

W. N. Harrison of the National Bureau of Standards submitted a confidential report on the special work which is being done by the Bureau staff on the development of new tests for porcelain enamels. He indicated that certain tests being studied may have important effects in the architectural and advertising fields.

Thomas B. Collins, Washington representative of the Porcelain Enamel Institute, explained the necessity of keeping open the channels of information with the various departments in Washington to assist them in the development of proper specifications for products.

Officers for 1941

President: P. B. McBride, Porcelain Metals Corp., Louisville, Ky.; *Vice-Presidents:* R. H. Türk, Porcelain Enamel & Mfg. Co., Baltimore, Md., and R. R. Danielson, Metal & Thermit Corp., Carteret, N. J.; *Treasurer:* Wm. Hogenson, Chicago Vitreous Enamel Product Co., Cicero, Ill.; and *Secretary:* Charles S. Pearce, Porcelain Enamel Institute, Chicago, Ill.

Executive Committee for 1941

Frit Division: J. E. Hansen, Ferro Enamel Corp., Cleveland, Ohio, and Ernest Hommel, O. Hommel Co., Pittsburgh, Pa.; *Jobbing Shop Division:* E. G. Walbridge, Erie Enameling Co., Erie, Pa., and Emmet Dwyer, Wolverine Porcelain Enameling Co., Detroit, Mich.; *Table-Top Division:* J. H. E. McMillan, Ingram-Richardson Mfg. Co., Beaver Falls, Pa., and E. H. Weil, Vitreous Steel Products Co., Cleveland, Ohio; *Sign Division:* George S. Blome, Baltimore Enamel & Novelty Co., Baltimore, Md., and F. E. Hodek, Jr., General Porcelain Enameling & Mfg. Co., Chicago, Ill.; *Cooperating Division:* H. V. Mercer, American Rolling Mill Co., Middletown, Ohio, and Bennett Chapple, Jr., Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

ARCHIPENKO ART SCHOOL SUMMER COURSE

The Archipenko Art School has announced a summer course to be held at Woodstock, N. Y. The summer session will begin June 2, 1941, and extend through August 23. The curricula will include sculpture, painting, drawing, and ceramics. The ceramic classes will study (1) design of models (originals or mass production), (2) technique of terra cotta, (3) building hollow statuary and polychrome terra cotta, and (4) laboratory work on firing and glazing.

Detailed information may be obtained by writing to the Archipenko Art School, Woodstock, N. Y.

LARGE PORCELAIN PART MADE BY IMPROVED EXTRUSION

The largest one-piece, wet-process porcelain part ever made by extrusion and turning is being manufactured on a production basis at the Derry, Pa., porcelain works of the Westinghouse Electric & Mfg. Company. The part, a cylindrical form for a resonant choke coil for electric transmission lines, has an outside diameter of $17\frac{1}{4}$ in. and it is $56\frac{1}{4}$ in. long. A helical "screw thread" in which the wire coil is wound on the finished piece is cut along the periphery of the form.

Extruding blanks for the largest wet-process porcelain part ever made

The secret of producing such a large piece by this method is an improvement in the extrusion process. Instead of using a screw pug to produce the final blank, a rough blank is re-extruded in such a way as to remove the helical twist put in it by the initial extrusion. The differential shrinkage of clay, usually about 6% on large extruded parts, has been reduced to 4% by this method, and the hazard of loss of blanks in the dry stage is about 25% less.

CELO KYANITE

UNIFORM QUALITY **DEPENDABLE SUPPLY**

FOR INFORMATION AND SAMPLES WRITE TO

CELO MINES, INCORPORATED

BURNSVILLE, NORTH CAROLINA

CHARLES W. FRANZHEIM

Although Charles W. Franzheim was not a potter, he was associated in the pottery business during most of his business career and was president of the Wheeling Pottery Company at the time of the celebration of its silver anniversary in 1904.

Charles W. Franzheim was born in Wheeling, W. Va., February 3, 1853, the oldest of six sons. He was graduated from Bethany in the class of 1874, a member of Phi Kappa Psi fraternity and valedictorian of his class. On graduation, he entered the banking business, and in 1880 he married Lida Riddle Merts of Ravenna, Ohio. Mr. Franzheim died in Wheeling, October 22, 1912.

Charles W. Franzheim, 1853–1912

When the Wheeling Pottery Company was organized in 1879 in what is known as the "old Wheeling Pottery," it was operated with five kilns and employed about 150 men. At first, only white granite ware or "Queensware," as it is more commonly known, was manufactured. Three or four years later, however, it began to decorate the ware, and in 1904, the plant was making everything from common sanitary ware to the finest china and was employing about 1200 persons. Although the plant was not the largest in number of kilns, the decorating departments employed a greater number of persons than any similar institution in the country.

There were four plants, with twenty-seven biscuit and glost kilns and twenty decorating kilns. Their production covered a wide range of ware, semigranite (or "C.C.") white granite, semiporcelain, and a line of highly decorated faience ware and sanitary goods.

The building, known as the LaBelle Pottery, on the South Side, was built in 1889, and the Ohio Valley China Company plant in North Wheeling, now known as the Riverside, was acquired in 1900. A little later, the Tiltonsville, Ohio, plant was added to the Company.

C. Merts Franzheim, the eldest son of Charles Franzheim, was assistant general manager in 1904, with direct supervision over the Wheeling and LaBelle plants. He spent two years at the ceramic school of the Ohio State University and one year in Germany at one of the celebrated pottery schools in that country.

In the early nineties, Anton Reymann of Wheeling established a chinaware plant in North Wheeling and brought Hermann Zimmer to this country from Germany. It was soon discovered that even though beautiful products were being made, the cost was so high that the Company could not compete with imported articles. This plant was closed about 1896, and Mr. Franzheim employed the services of Dr. Zimmer for the Wheeling Pottery Company to develop a better grade of earthenware art objects and china. Dr. Zimmer thus became one of the first ceramic engineers in this country.

Dr. Zimmer developed the Cameo chinaware, but that too was unprofitable owing to the high cost of production as compared with the imported articles of the same nature and also to the lack of real artists at reasonable cost.

In the nineties, Mr. Franzheim became president of the Warwick China Company for two years, but he then returned to the Wheeling Pottery Company. He served as president of the United States Potters' Association for one year. With Frank Sebring and Fred Gosser, he developed and used Texas clay at their plants.

The Wheeling Pottery Company was the first to make extensive use of the casting process in this country, which was directly due to the continental experience and the assistance given by Rudolph Gaertner.

WHY ANNUAL MEETING REGISTRATION FEES

After years of experience, study, and trials of various schemes, the Board of Trustees of The American Ceramic Society has adopted the policy of financing all Annual Meeting expenses from registration fees.

The cost of building and operating the Annual Meeting programs has always been financed by The Society.

The cost of entertainment at the Meetings for several years was paid by the Local Committees. This was an imposition. For the last five years The Society has appropriated $1000 for entertainment.

Meetings Must Be Financed

The Society would lose its status with the several federal and state taxing agencies as strictly a scientific, technical, and educational organization should it finance any portion of its Meeting expenses by holding commercial exhibits.

To finance the Meetings out of the general funds would mean (1) making all members of The Society pay for the advantages enjoyed only by those who attend, (2) making Meeting privileges available without cost to many persons who are not members, and (3) using the money for Meetings that presumably is to be expended only for publications and for operating The Society.

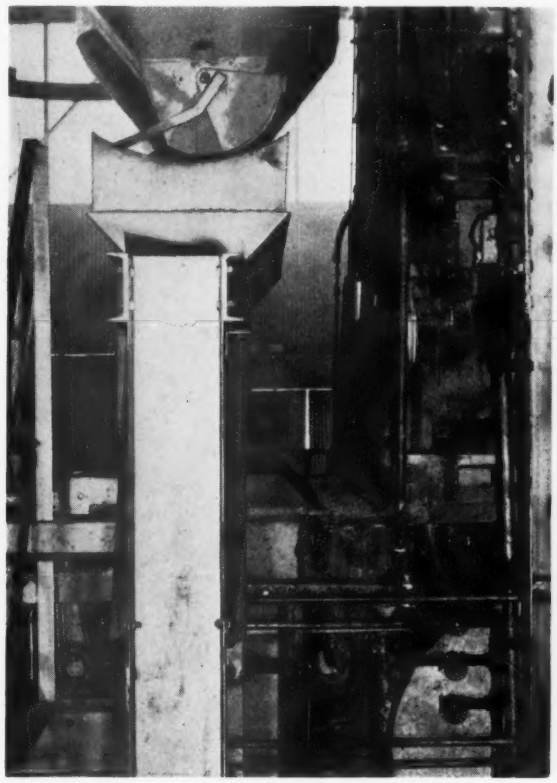
Meeting together, working together, and communing together make for personal and industrial progress. These are reasons why Meetings are held. The research reports obtained would not alone justify the holding of Meetings for these could be obtained in other ways with much less effort and expense.

The most generally satisfactory and certainly the most practical scheme is to finance the Meetings exclusively by registration fees, viz., $5.00 for delegates, $1.50 for students, and $1.00 for women.

The Profit and Loss Statements for several Meetings are as follows:

Date	Place	Profit	Loss
1921	Columbus		$1667.27
1922	St. Louis		1301.26
1923	Pittsburgh		1455.17
1924	Atlantic City		1522.40
1925	Columbus		2470.45
1926	Atlanta		1410.28
1927	Detroit		2078.49
1928	Atlantic City		1276.83
1929	Chicago	$143.04	
1930	Toronto		798.44
1931	Cleveland	666.90	
1932	Washington, D. C.		873.24
1933	Pittsburgh	125.21	
1934	Cincinnati		160.00
1935	Buffalo	460.16	
1936	Columbus		365.92
1937	New York		439.03
1938	New Orleans		1286.00
1939	Chicago	554.44	
1940	Toronto	119.79	
1941	Baltimore	524.77	
		$2594.34	$17,104.78

It Is Only by Communication with Others That Knowledge Is Acquired; Membership in The American Ceramic Society Is Opportunity for This Achievement



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Norton Co.
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Norton Co.

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National Engineering Co.

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Norton Co. (*Alundum-Crystolon*)

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Foote Mineral Co.

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Harshaw Chemical Co.
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Bone Ash
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Harshaw Chemical Co.
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Denver Fire Clay Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pacific Coast Borax Co.
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Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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The Hommel, O., Co., Inc.
Pacific Coast Borax Co.
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Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

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Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
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Pacific Coast Borax Co.
The Vitro Mfg. Co.

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Norton Co.

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Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Carborundum Co.

Carbonates (Barium, Lead)
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The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

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Denver Fire Clay Co.
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Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

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Corhart Refractories Co.
Norton Co.
Pennsylvania Salt Mfg. Co.

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Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
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The softening depends also upon the viscosity of the melt, which in turn depends upon the composition of the minerals from which the melt has formed.

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French Flint
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Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Frazier-Simplex, Inc.
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Ingram-Richardson Mfg. Co. of Indiana, Inc.
Swindell-Dressler Corp.

Furnaces, Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Lancaster Iron Works, Inc.

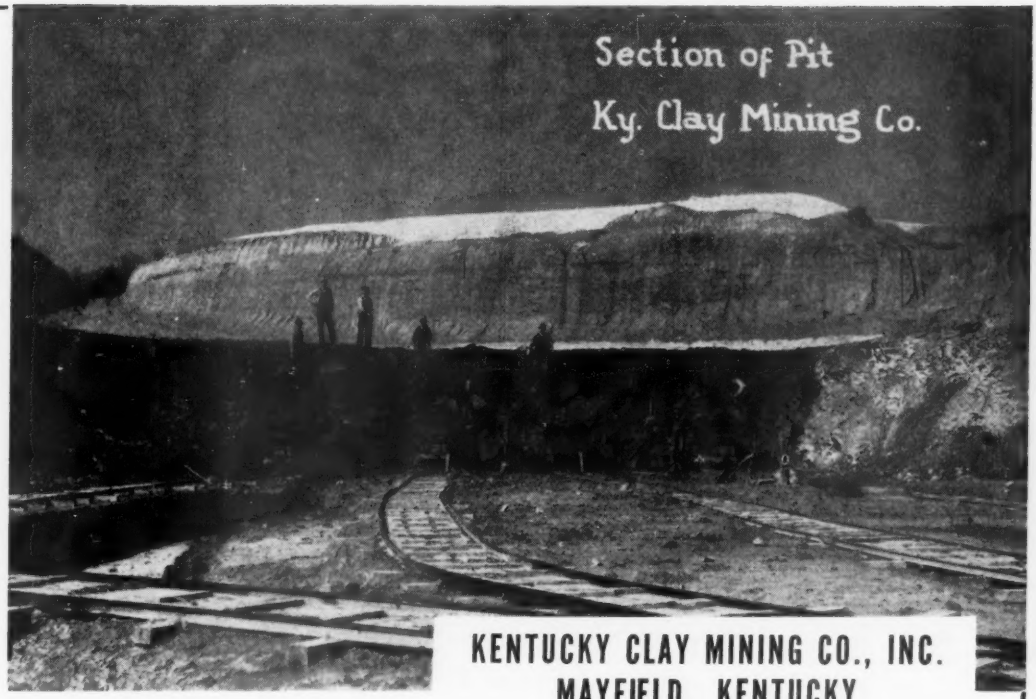
Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Sand
Great Lakes Foundry Sand Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

QUALITY BALL CLAYS



KENTUCKY CLAY MINING CO., INC.
MAYFIELD, KENTUCKY
V. J. Roehm, Alliance, Ohio

. . Produce Better Ware . .

Eastern Sales Representative
Enterprise White Clay Co.
Philadelphia, Pa.

Western Sales Representative
Mineral Products Company
Huntington Park, Calif.

Wanted! to Buy.

JOURNALS
June 1921, Part II
April 1922, Part II
January, June and Yearbook 1923
January and February 1924
January 1928
January, February and October 1933
January and February 1934

BULLETINS
April and June 1936
January 1937
April and May 1938
February 1939

AMERICAN CERAMIC SOCIETY
2525 North High Street, Columbus, Ohio

99 1/2 % PURE KAOLINITE
"Properly Priced for Very Large Users"
Write for Information and Samples
P. C. E. CONE 35
THE THOMAS ALABAMA KAOLIN CO.
2412 Ken Oak Road, Baltimore, Md.
Mines: Chalk Bluff, Ala. Processing Plant: Hackleburg, Ala.

Analysis	Loss on ignition	13.89%
	Silica (SiO_2)	44.74
	Aluminum oxide (Al_2O_3)	39.47
	Titanium oxide (TiO_2)	1.29
	Ferric oxide (Fe_2O_3)	0.55
	Lime (CaO)	0.00
	Magnesia (MgO)	0.00
	Alkalis (Na_2O,K_2O)	0.00
Mechanical Composition	—20 microns	98.00%
	—10 "	80.98
	— 6 "	70.94
	— 3 "	54.70
	— 1 "	37.74
	— 0.5 "	21.75

INDUSTRIAL CERAMIC PRODUCTS, Inc.
MANUFACTURERS
PINS CONE PLAQUES STILTS
COLUMBUS, OHIO

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Goggles
The Hommel, O., Co., Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

Granulators
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hydrofluoric Acid
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Iron Chromite
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Thomas Alabama Kaolin Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kilns, China (Decorating)
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
The Hommel, O., Co., Inc.
Swindell-Dressler Corp.

Kilns (Electric, Circular, Tunnel)
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Louthan Mfg. Co.

Kyanite
Celo Mines, Inc.

Kryolith (see Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Lehrs
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick, and Tile)
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.
The Vitro Mfg. Co.

Lithium Carbonate
Drakenfeld, B. F. & Co.,
Foote Mineral Co.

Lithium Minerals
Foote Mineral Co.

Loaders (Bucket)
National Engineering Co.

Magnesia (Fused)
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote Mineral Co.
The Hommel, O., Co., Inc.

Magnesium Carbonate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Manganese Dioxide
Drakenfeld, B. F., & Co.
Foote Mineral Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Masks (Breathing)
Drakenfeld, B. F., & Co.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Micronized Products
Porcelain Enamel and Mfg. Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Mixers
National Engineering Co.

Mixers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)
Lancaster Iron Works, Inc.

Mixers (Laboratory)
Lancaster Iron Works, Inc.
National Engineering Co.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace) (Laboratory)
Carborundum Co. (*Carbofrax*)
Denver Fire Clay Co.
Frazier-Simplex, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.

Mullers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Nepheline Syenite
Great Lakes Foundry Sand Co.

Nickel Salts
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

Pins
The Hommel, O., Co., Inc.
Industrial Ceramic Products, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Placing Sand
Great Lakes Foundry Sand Co.
United Clay Mines Corp.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

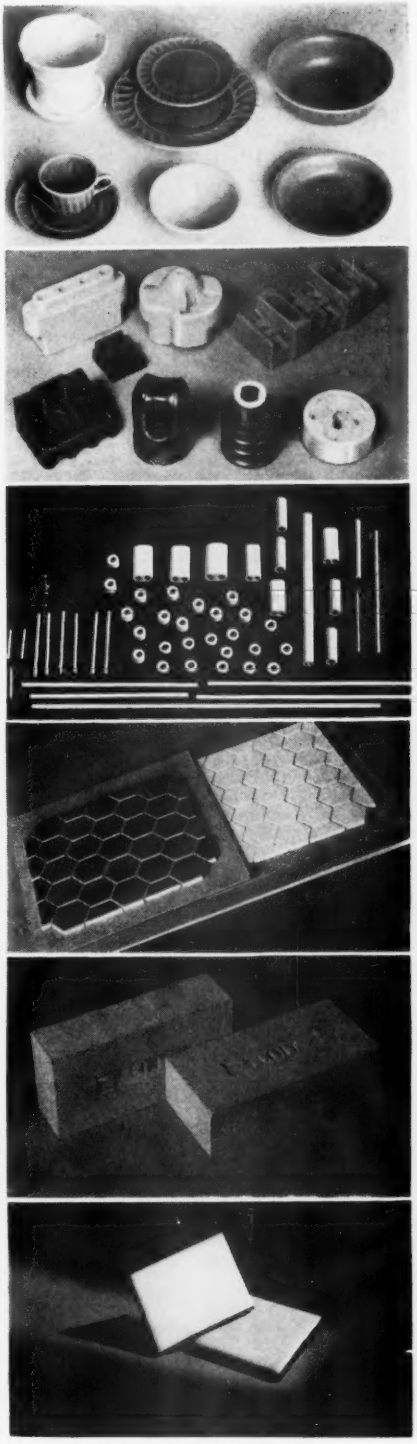
Potters Wheels
Denver Fire Clay Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.

USE SIMPSON *Intensive Mixers*

FOR { IMPROVED PRODUCT QUALITY
GREATER UNIFORMITY
REDUCED WASTE OR SCRAP
REDUCED LABOR COST
REDUCED MIXING TIME

Listed above are five of the important advantages you get when you use Simpson Mixers for the "controlled mixing" of ceramic bodies. These modern units, built in 10 sizes, assure control of all material to desired specifications. Close adherence to required properties is also obtained, giving bodies increased strength—all due to the intensive MULLING action imparted by heavy, wide-faced mullers. Let us show you how Simpson Intensive Mixers will help solve your mixing problems.



• **RIGHT:** Illustrations of representative pottery, electrical porcelain, insulators, tile, dry press refractory brick and enamel frit made from bodies prepared by mulling in Simpson Mixers. Clays and moisture are accurately proportioned so that the make-up of each succeeding batch is identical, with a resultant high degree of uniformity of the body for forming and of the finished ware.

• • •

• **LEFT:** No. 2—6 ft. dia. pan Simpson Intensive Mixer. This heavy-duty unit has a capacity of 10 to 15 cu. ft. per batch, with 15 to 20 H.P. motor, depending on the type of body.

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Solvay Sales Corp.
The Vitro Mfg. Co.

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Pug Mills
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Pyrites (Natural Iron Sulphide)
Foote Mineral Co.
The Hommel, O., Co., Inc.

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Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Leeds & Northrup Co.
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
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Raw Material Handling Equipment
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Lancaster Iron Works, Inc.

Refractometers
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Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
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Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.
Thomas Alabama Kaolin Co.
Titanium Alloy & Mfg. Co.

Respirators
Drakenfeld, B. F., & Co.
The Hommel, O., Co., Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
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Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Corp.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Sand
Great Lakes Foundry Sand Co.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel, O., Co., Inc.

Screening and Magnetic Separators
National Engineering Co.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.

Silica (Fused)
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Silicate of Soda
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Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Silicon Carbide
Carborundum Co.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.

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Norton Co.

Soda Ash
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Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
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Harshaw Chemical Co.
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Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
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Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Sodium Uranate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Pennsylvania Pulverizing Co.
The Vitro Mfg. Co.

Spray Booths
The Hommel, O., Co., Inc.

Spraying Equipment
The Hommel, O., Co., Inc.

Spurs
Louthan Mfg. Co.
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Lancaster Iron Works, Inc.

Stilts
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Industrial Ceramic Products, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Paper Makers Importing Co.

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Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
The Hommel, O., Co., Inc.

Tanks for Raw Material Steel or Concrete
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Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Norton Co.

Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Denver Fire Clay Co.
Norton Co.
Thomas Alabama Kaolin Co.

Tile (Wall)
Denver Fire Clay Co.
Thomas Alabama Kaolin Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Trisodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Uranium Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Uranium Oxide (Yellow-Orange-Black)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Water Softening Plants
Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Zircon
Foote Mineral Co.
The Hommel, O., Co., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Zirconium Oxide
Foote Mineral Co.
The Hommel, O., Co., Inc.
Titanium Alloy Mfg. Co.

Zirkite (Natural ZrO_2)
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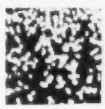
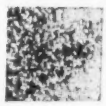
"Re-tooling" Glass Production

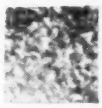
MODERN GLASS is the result of new, improved technology—and new types of basic materials. Here are outstanding factors in this "tooling up" of glass production—all BETTER MATERIALS produced by Solvay:



SOLVAY DUSTLESS CALCINED POTASSIUM CARBONATE 98-100% — *Especially developed by Solvay for the glass industry.* Used to produce special glass such as optical glass and fine stemware, this product was a major development for the glassmaker. *It is free from dust* and therefore prevents costly losses. Its "homogeneous" physical characteristics, as in the case of Solvay Dustless Dense Soda Ash, result in important production savings.



SOLVAY DUSTLESS DENSE SODA ASH— *Especially developed by Solvay for the glass industry.* Highly pure, highly uniform, for all practical purposes free from dust. Its density and granulation assure perfect blending with other ingredients. Prevents loss of valuable materials, helps maintain control over glass melts.



SOLVAY GRANULAR HYDRATED POTASSIUM CARBONATE 83-85%—Available for those who prefer the hydrated type. A high quality granular product, also essentially free of dust.

AN OUTSTANDING TECHNICAL SERVICE FOR GLASSMAKERS—Solvay is well equipped to render technical assistance on glassmaking problems as they relate to the use of alkalies. Prompt and individual attention by glass technologists is given all inquiries.

60th ANNIVERSARY 1881 • 1941

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 Rector Street New York, N. Y.

ADVERTISE IN THE BULLETIN

The Bulletin is a valuable advertising medium for Ceramic Advertisers because it reaches the executives in all the branches of ceramics who decide what materials and equipment are to be purchased and used.

NOTE:

The advertising rates are low because The Society is not operating for profit and does not employ advertising solicitors—all money earned is used to further the activities of The Society which is owned and managed by its members.

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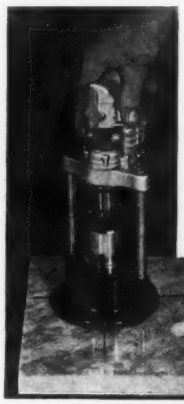

Drills Perfect HOLES or CORES at HIGH SPEED and LOW COST

The H-S Portable Abrasive Speed Drill drills a clean, sharp, accurate hole in a fraction of time required by other methods. Example: 1½″ diameter hole in ¼″ plate glass in 60 seconds. Easy, safe to operate—no special skill required. Horizontal or vertical drilling. Drills all Ceramic Materials. Send for free, descriptive folder listing nationally known users.

HOWE-SIMPSON, Inc.
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H-S Portable SPEED DRILL

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HI-FIRE *Refractories*

PINS · STILTS · SPURS
DECORATING THIMBLES
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THE LOUTHAN MANUFACTURING CO.
CERAMIC SPECIALISTS SINCE 1901
NEW YORK EAST LIVERPOOL, OHIO LOS ANGELES

All Types of Circular and Straight Tunnel Kilns

SWINDELL-DRESSLER CORPORATION

Post Office Box 1888 **Pittsburgh, Pa.**

Lehrs and Enameling Furnaces, Electric and Gas Fired

Full Details Furnished on Request

POTTERIES - PLASTIC MFG.

Patented sanitary-airtight-money-space saving, refrigerator pitcher.

Sanitary features alone, besides other ones, needed in every home, institution, etc.

A money maker for a live manufacturer.

Royalty basis, write,

Dod Haslup
Grafton, West Virginia

CERAMITALC

Registered in U. S. Patent Office

For—WALL TILE
DINNERWARE and
REFRACTORY BODIES

LIBERAL SAMPLES FREE

INTERNATIONAL PULP CO.
41 PARK ROW NEW YORK

THE SHARP-SCHURTZ COMPANY

CHEMISTS FOR THE CERAMIC INDUSTRY

WE HAVE FULLY EQUIPPED LABORATORIES AT

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ANALYSES: CERAMIC RAW MATERIALS AND PRODUCTS, FUELS, IRON AND STEEL, ETC.

SPECIAL INVESTIGATIONS: PHYSICAL AND CHEMICAL TESTS ON ENAMEL, ETC.

309 McCALLIE AVE.,
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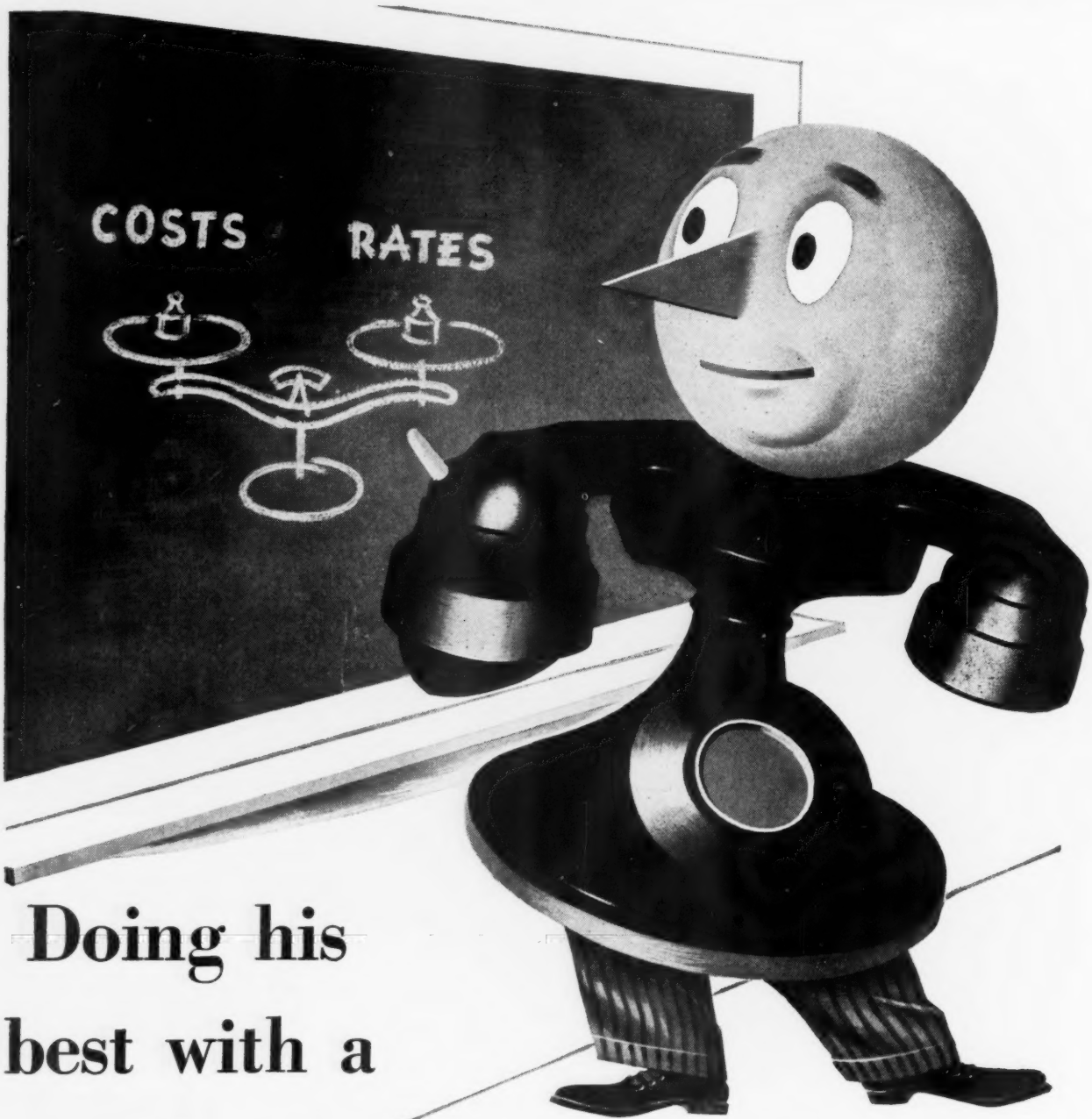


Doing his best with a tough job

The hardest job of the Bell System is to give you more and better telephone service and yet keep rates low. It isn't easy to keep those two things in balance. Increasing costs and taxes make it difficult.

But there is no end to trying. There is never any letting up in the search for a better, more economical way. All along the line, the Bell System believes in economy in business housekeeping. That is part of its obligation to the public.

BELL TELEPHONE SYSTEM

Listen to "The Telephone Hour" every Monday. (N. B. C. Red Network, 8 P. M., Eastern Daylight Saving Time.)

H. C. SPINKS CLAY COMPANY

Miners and Shippers of

BALL, SAGGER AND WAD CLAY

NEWPORT, KY.

May 1, 1941

Mr. Pete Potter

Comfortable Sanitary Pottery Mfg. Co.

Pottsville, U. S. A.

Dear Pete:

With the dragline busy digging clay, new calves and colts playing in the pastures, and Porter's Cap making me think he can win the Derby, surely it is springtime in Dixie.

Hope we see you in Louisville.

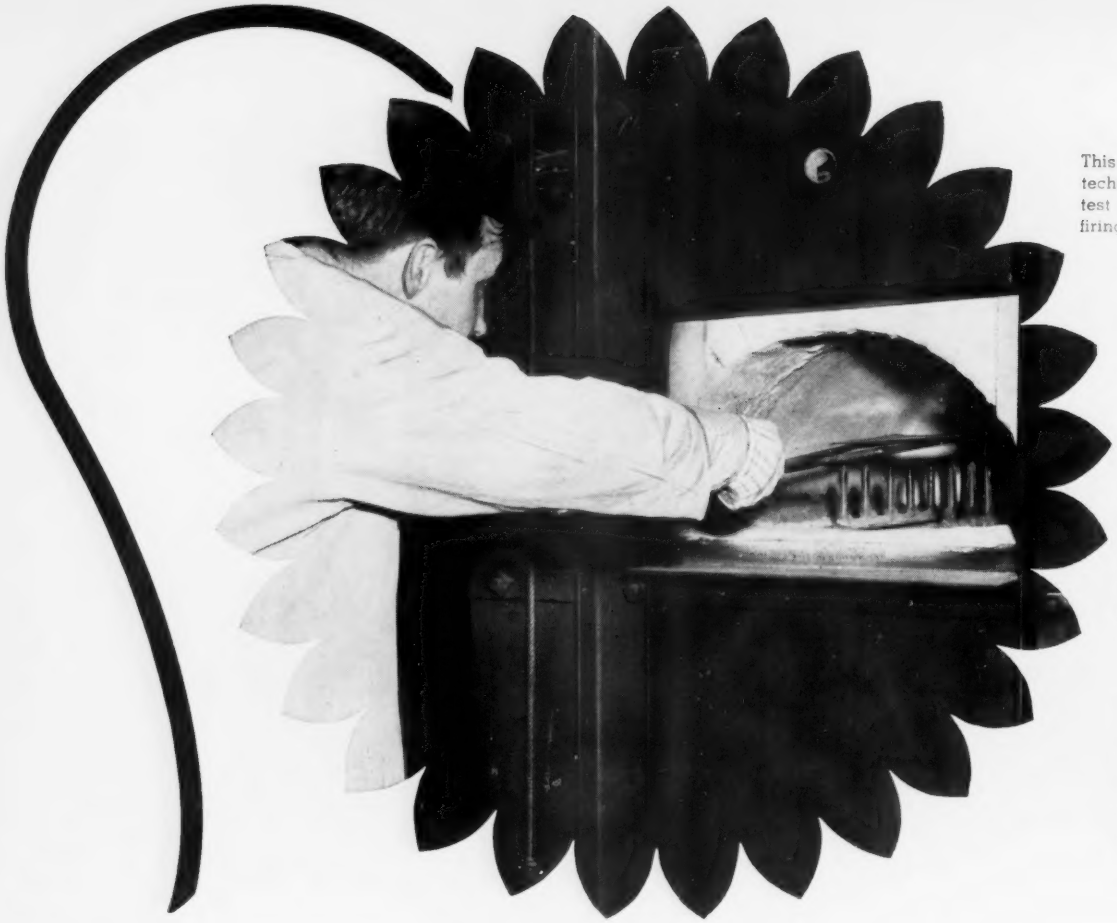
Sincerely,

Dick Carothers

General Manager

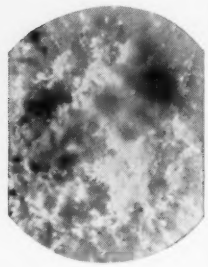
H. C. SPINKS CLAY COMPANY

RBC:MLN



This Metal & Thermit technician is placing a test plate in furnace for firing.

Photomicrograph of sunflower, showing erupted material. Analysis in Metal & Thermit laboratory found cause to be tramp iron in batch.



the man with the sunflowers

Sunflowers may be all right in your garden, but they can prove to be an exasperating and costly source of trouble to ceramic manufacturers.

A prominent manufacturer of sanitary ware recently had to shut down his plant because of "Sunflowers" in the enamel. Analysis of his enamel at our ceramic laboratory traced this condition to the presence of tramp iron in the enamel batch. The condition was quickly cleared up and production resumed.

This is one of many case histories from our files which illustrate the service rendered by our engineering department. Our laboratory is equipped to manufacture test batches of glazes for tile, vitreous china and enamel for metal finishes — under exact working conditions.

Production difficulties are thus eliminated—avoiding costly shut downs and time lost in experimentation. Inquiries are invited.

Manufactured by a company with a long and intensive experience in the production of chemicals for many manufacturing processes, M & T Tin Oxide is noted for its purity and uniformity as an opacifier for ceramic glazes.

M & T Sodium Antimonate, checked against 11 physical and chemical enameling tests, gives a brilliant, uniform finish to porcelain enamels.

M&T

TIN OXIDE

SODIUM ANTIMONATE

★

METAL & THERMIT CORPORATION

120 BROADWAY NEW YORK, N. Y.